BASELINE RISK ASSESSMENT

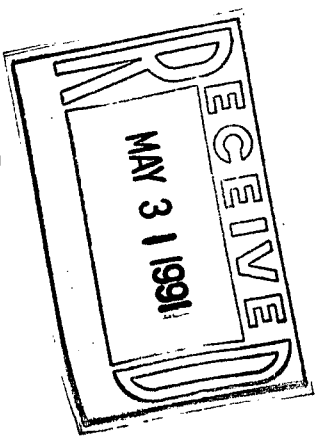
L.E. CARPENTER AND COMPANY

WHARTON, NEW JERSEY

FINAL

Prepared by

ROY F. WESTON, INC.
West Chester, PA 19380



MAY 1991

W.O. 3600-04-52

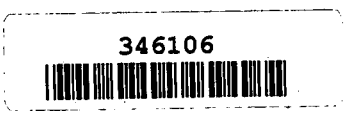


TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

BASELINE RISK ASSESSMENT
SECTION 1
INTRODUCTION

1.1 OVERVIEW

This baseline risk assessment was prepared as part of the Remedial Investigation/Feasibility Study (RI/FS) performed for L.E. Carpenter and Company (L.E. Carpenter) at its Wharton, New Jersey facility. The facility is included on the National Priorities List (NPL) under the Comprehensive Environmental Responses Compensation and Liability Act (CERCLA). Under CERCLA, action selected to remedy these sites must be protective of both human health and the environment (EPA, 1989a). This final risk assessment includes revisions as suggested by the New Jersey Department of Environmental Protection (NJDEP) in the letter dated 7 February 1991 relative to the draft risk assessment dated 20 November 1990.

The specific objective of this baseline risk assessment is to establish the potential risk to humans or the environment under present use and future use conditions at the site. Estimates of risk caused by exposure to surface soil, groundwater, surface water, and sediments were generated to determine the degree to which site-related substances in any of those media present a potential hazard within a given medium or, collectively, across all media. If an unacceptable risk is found to exist in one or more media under present or future use conditions, the need to control exposures and/or to implement remedial measures to reduce the risk to within Agency guidelines is indicated.

This risk assessment is based on site data presented in the following documents:

- "Revised Report of Remedial Investigation Findings," Volumes I, II, and III. GeoEngineering, Inc. and Roy F. Weston, Inc., June 1990.
- "Report of Supplemental Sampling Findings, L.E. Carpenter and Company, Wharton, New Jersey, Site," Volumes I and II. Weston Services, Inc., November 1990.

- Results of additional sediments sampling collected by WESTON, 18 April 1991.

1.2 SITE BACKGROUND

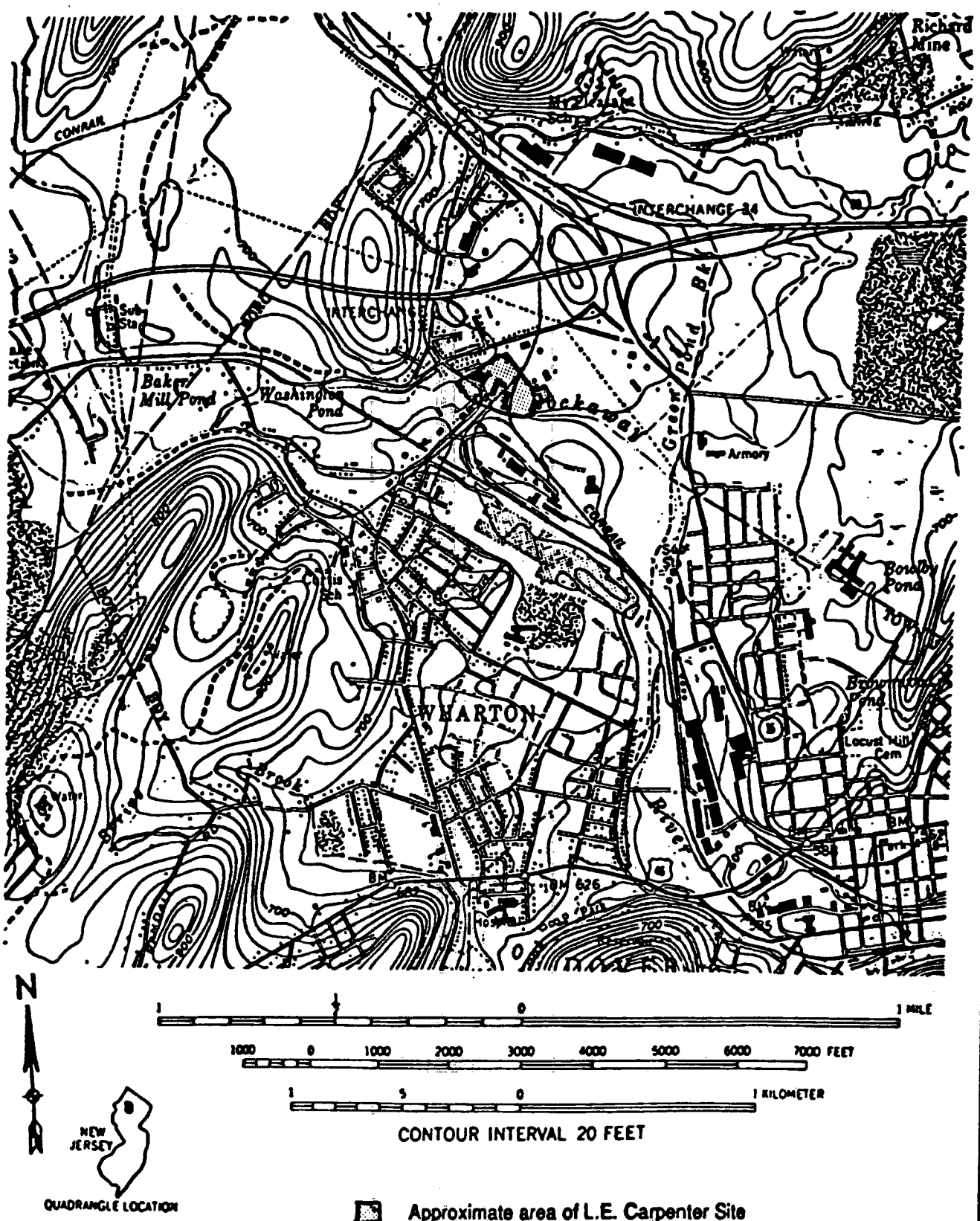
This section identifies the baseline setting for the L.E. Carpenter facility in terms of current area population and land uses. The area of analysis includes the plant complex and the surrounding area within a 1-mile radius of the facility encompassing sections of the Borough of Wharton in Rockaway Township, and the Town of Dover. The regional location of the facility and its pertinent surroundings are shown in Figure 1-1.

1.2.1 Site History

During the mid-to late 1800s, the site was used as an iron ore mine and forge. In the late 1800s, textile manufacturing began on the property. L.E. Carpenter and Company manufactured vinyl wall coverings at the site from 1943 until July 1987. Since then, portions of the property have been leased to several companies for administrative, warehousing, or distribution uses.

1.2.2 Demographic Setting

Demographic data for the study are available from both the U.S. Bureau of the Census and the Morris County Planning Board. The Bureau of the Census estimates of the local population in the analysis area are provided on page 1-4.



SOURCE: BASE MAP ADAPTED FROM USGS 7.5 MINUTE SERIES, DOVER, NJ QUADRANGLE, 1981

L.E. CARPENTER AND CO.
WHARTON, NEW JERSEY

FIGURE 1-1
SITE LOCATION AND TOPOGRAPHIC MAP

Population Center	Population		Change, 1980 to 1988	
	July 1, 1988 (estimate)	April 1, 1980 (census)	Number	Percent
Borough of Wharton	5,520	5,485	35	0.6
Rockaway Township	19,520	19,820	-30	-0.2
Dover	13,960	14,681	-721	-4.9
Morris County	420,700	407,630	13,070	3.2

SOURCE: Adapted from the U.S. Bureau of the Census, Current Population Reports, Series P-26, 710.88-NE-SC, *1988 Population and 1987 Per Capita Income Estimates for Counties and Incorporated Places: Northeast*, U.S. Government Printing Office, Washington, DC 1990.

Projected population figures for the analysis area, as estimated by the Morris County Planning Board, include:

Population Center	Population Projection	
	1990	2000
Borough of Wharton	6,480	7,390
Rockaway Township	19,520	21,420
Dover	15,630	16,310
Morris County	439,850	496,810

SOURCE: Morris County Planning Board (MCPB) *Revised Morris County Projections*, MCPB, October 1986.

1.2.3 Land Use

The L.E. Carpenter and Company Facility, Wharton, NJ, occupies approximately 14.6 acres, northwest of the intersection of the Rockaway River and North Main Street. The site is situated within a heavily industrialized area. The Rockaway River borders the site to the

south; a vacant lot lies to the east; Air Products, Inc. (a large compressed gas facility) borders the site to the northwest. Located to the south of the site, across the Rockaway River, are additional industrial sites including the facility known as Lock Joint Inc.; New Jersey Environmental Compensation Responsibility Act (NJECRA) Case Number 87388. Ross Street separates the residential portion of the Borough of Wharton from the northwestern side of the site (Figure 1-2).

Approximately 15% of the 14.6-acre property is occupied by buildings. The Rockaway River runs through approximately 13% of the property. Pavement associated with the buildings and access roads comprise approximately 22% of the site.

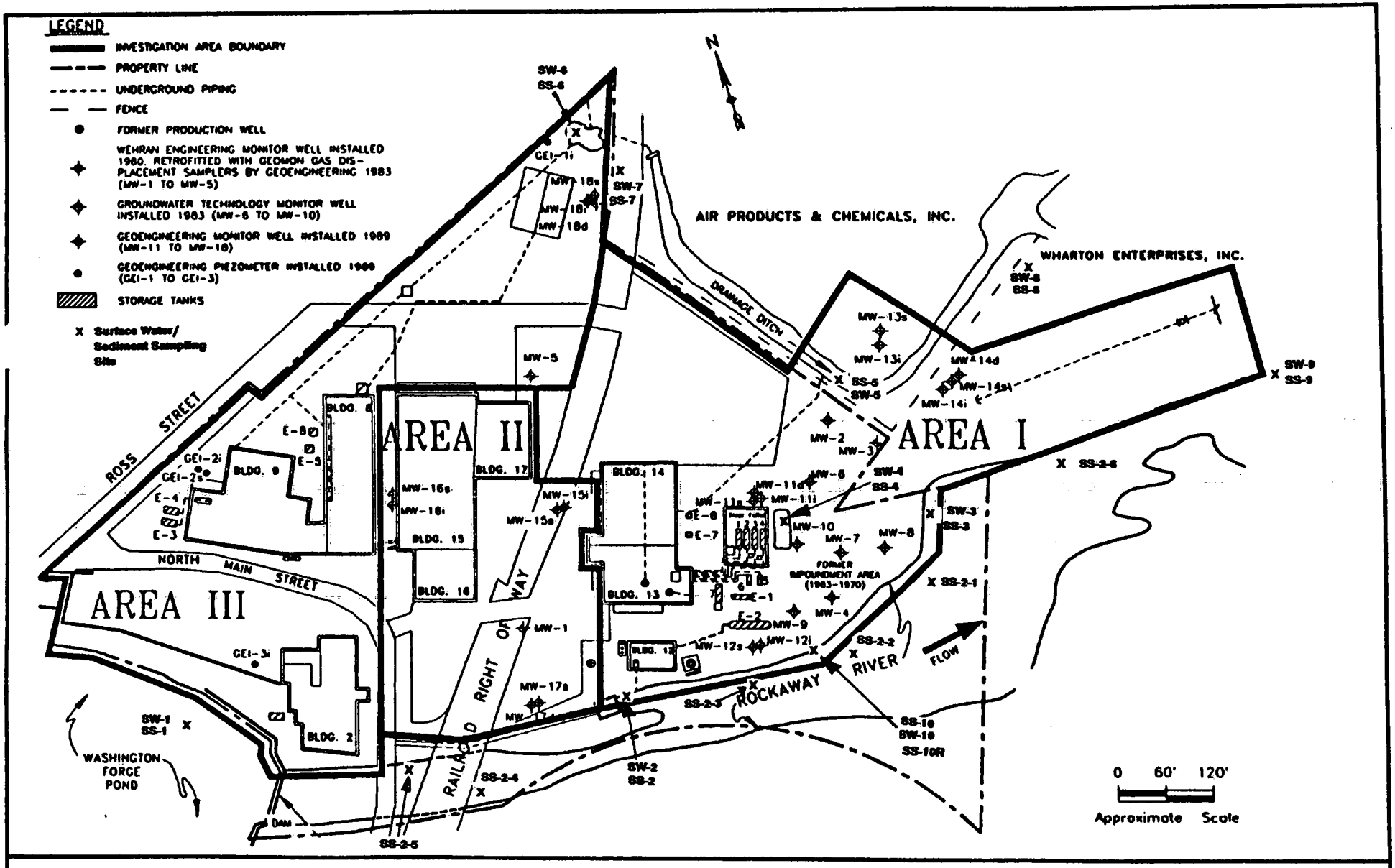
All vehicles enter the site either by North Main Street, which crosses the site, or at the northwestern property entrance along Ross Street. The site is enclosed by a security fence except along the Rockaway River and small section of the property between Washington Forge Pond and North Main Street which is used as a parking lot for Building 2. Security gates are located at the fenced entrances to the property.

The following generalized land use categories were identified within a 1-mile radius of the site (USGS, 1981).

- Residential
- Commercial
- Industrial
- Public/semi-public (institutional)
- Recreational/open space
- Open land/agricultural

1.2.4 Areas of Concern at the Site

The property is divided into three areas of concern (Areas I, II, and III) based on previous manufacturing-related activities (see Figure 1-2).



SOURCE: BASE MAP FROM DRAWINGS SUPPLIED BY L.E. CARPENTER & CO. - FROM GEOENGINEERING

L.E. CARPENTER AND CO.
WHARTON, NEW JERSEY

FIGURE 1-2
SITE MAP AND
AREAS OF CONCERN

Area I

Area I, located in the southeastern portion of the site, has three locations of concern:

(1) The former impoundment area;

(2) The tank farm area; and

(3) The abandoned Rockaway Valley Regional Sewerage Authority (RVRSA) sewer line.

The former impoundment area was utilized to dispose of cleaning solvents and manufacturing wastes from 1963 to 1970. During the late 1970s and early 1980s, the NJDEP conducted sampling of soil and groundwater in the area of the former impoundments and detected volatile organics, base neutral organics, metals, and PCBs.

Several of the monitoring wells located in Area I contain floating product. L.E. Carpenter has been collecting the immiscible product from a network of monitoring wells and is installing three more wells. As of November 1990, approximately 5,500 gallons have been recovered.

Area I contained several above- and belowground tanks. Seven tanks contained chemicals used in the manufacturing process, two tanks contain fuel oil, and two others contain condensate from air pollution control equipment. All underground storage tanks and associated piping were removed in February to April 1991 in accordance with an NJDEP approved closure plan (January 1991).

The last location of concern in Area I is the abandoned RVRSA sewer line. In the late 1970's, the sewage authority developed a plan to run a sewerline along the south side of the Air Products & Chemicals, Inc. property which is adjacent to the L.E. Carpenter facility. The project was terminated and the sewer line was re-routed.

Area II

Area II contains a former production well. Groundwater in this area has been shown to contain ethylbenzene and xylene.

Area III

Area III encompasses the "desizing" process waste tanks, and former starch drying beds, as well as two Smog Hog condensate tanks, and two ink/solvent tanks. "Desizing" is a process used to remove impurities from the cotton fabric used in the manufacture of vinyl wall coverings. Desizing activities occurred at the site between 1962 and 1972. The hot water, starch, and cotton impurities stored in these tanks were eventually pumped to the starch drying bed. The microbial activity of the soils removed the starch and impurities. The 550-gallon condensate tanks contain contents similar to those found in Area I. Two buried 10,000-gallon tanks were used to store methyl ethyl ketone (MEK), collected waste MEK, and waste pigments from the printing process. Underground storage tanks in the area were removed in February 1991 in accordance with the tank closure plan.

Other areas of concern include the Air Products, Inc. drainage ditch bordering the northeast portion of the property and specific sediment sampling locations along the Rockaway River bordering the south side of the property.

1.3 ORGANIZATION OF RISK ASSESSMENT REPORT

The baseline risk assessment is composed of two principal sections. An evaluation of impact potential to humans is presented in the Human Health Evaluation (HHE) portion of this report (Sections 1-5) and the environmental impact evaluation may be found in the Ecological Assessment (EA) in Section 6.

Several sources were consulted for technical guidance during the performance of this risk assessment, including the *Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A* (EPA, 1989a) and the companion "Standard Default Exposure Factors" document (EPA, 1991); *Risk Assessment Guidance for Superfund, Vol. II. Environmental Evaluation Manual*, Interim Final, OERR; EPA/540/1-89/001, March 1989 (EPA, 1989b); and *Risk Assessment Guidelines for Resource Recovery Facilities* (NJDEP, 1990); Additional guidance on the scope of this risk assessment was provided in correspondence from NJDEP to M.A. Hanna Company, dated 28 August 1990 (see Kaup, 1990).

1.4 REFERENCES

EPA (U.S. Environmental Protection Agency), 1989a. *Risk Assessment Guidance for Superfund. Human Health Evaluation Manual - Part A.* Interim Final. Office of Solid Waste and Emergency Response. Washington, DC. OSWER Directive 9285 7-01a.

EPA (U.S. Environmental Protection Agency), 1989b. *Risk Assessment Guidance for Superfund, Vol. II. Environmental Evaluation Manual*, Interim Final, OERR; EPA/540/1-89/001, March 1989.

EPA (U.S. Environmental Protection Agency), 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual *Supplemental Guidance*, "Standard Default Exposure Factors," Interim Final. OSWER Directive 9285.6-03.

NJDEP (New Jersey Department of Environmental Protection), 1990. *Risk Assessment Guidelines for Resource Recovery Facilities, Draft.*

Kaup, E. 1990. Certified correspondence to C.R. Anderson, Environmental Affairs Manager, M.A. Henna Co., from Edgar Kaup, P.E., Case Manager, NJDEP. (Dated: 28 August 1990).

USGS (U.S. Geological Survey) 1981. 7.5 Minute Series Quadrangle Map, Dover, New Jersey.

SECTION 2

IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

2.1 GENERAL DATA COLLECTION CONSIDERATIONS

Contaminants of potential concern were selected using sampling data collected for the *Revised Report of Remedial Investigation Findings: Volumes I, II, and III* (GeoEngineering, Inc. and Roy F. Weston, Inc., 1990) the *Report of Supplemental Sampling Findings, L.E. Carpenter and Company, Wharton, New Jersey Site: Volumes I and II* (Weston Services, Inc., 1990), and sediment sampling conducted by WESTON 18 April 1991.

2.2 ENVIRONMENTAL DATA EVALUATION

2.2.1 Screening of Laboratory Data

In evaluating the data to yield the chemicals of potential concern, the following guidelines were considered:

- A substance was eliminated from further consideration if it was not reported in any sample analyzed within a particular medium (i.e., groundwater, surface water, sediments, soil, or air).

- Concentrations of common laboratory contaminants such as acetone, methylene chloride, phthalate esters, toluene, and methyl ethyl ketone (2-butanone) were compared with concentrations in the blank samples. Where the concentration of any one of these chemicals in the field sample was less than 10 times that found in the corresponding blank, the field sample concentration was not considered further (EPA, 1989a).

- Chemicals occurring in blanks that are not common laboratory contaminants were disregarded if the chemical was not present in the field samples at concentrations greater than five times that present in the blank (EPA, 1989a).

- When a particular substance was detected at least once in a specific medium, all samples below the quantification limit for that organic or inorganic substance were considered to contain the lesser of one-half the reported quantification limit or the lowest J value. The exception was when quantification limits for a given sample batch were greater than the maximum

concentration recorded for that substance. In those instances, if the number in question caused the average to exceed the maximum, the data were not used further in the risk assessment.

Certain chemical species with two or more isomeric forms could not always be separated for analysis. These included 1,2,3-trimethylbenzene and 1,2,4-trimethylbenzene; and benzo(b)fluoranthene and benzo(k)fluoranthene. Where separate analyses were performed for these isomeric pairs, the data were combined using the following methods:

- If both chemicals isomers were detected or were reported as a J value, the sum of those values was used.
- If only one chemical of an isomer pair was detected or a J value was reported, and the other isomer was not detected, the sum of the positive sample value and one-half the non-detect's quantification limit (or the lowest J value for that individual substance, whichever was lower) was used.
- If both chemicals of an isomeric pair were not detected in a particular sample, but were detected in a different sample in the same medium, the sum of one-half of the respective quantification limits was used.
- If separate analyses were performed for one round of sampling but the analyses were combined for another round (i.e., benzo(b)fluoranthene and benzo(k)fluoranthane) data were combined and the average of the sums for each round was used.

2.2.2 Groundwater Data Evaluation

Based on the results of the hydrogeologic investigation, water samples taken from different depths (shallow, intermediate, and deep) are all evaluated separately. Two rounds of groundwater sampling were completed several months apart.

If a contaminant was present during only one round of groundwater testing, sample concentrations in the non-detect round were assigned one-half the quantification limit.

Detection limits for metals were available for groundwater in samples taken in the first round of sampling only. Therefore, to avoid an underestimation of metal concentrations,

one-half of the contract required detection limits (CRDLs) were substituted in Round 2 where the use of the detection limits was necessary in calculating potential exposure concentrations. The CRDLs used in the risk assessment were as shown below.

Substance	CRDL (µg/L)
Antimony	60
Arsenic	10
Beryllium	5
Cadmium	5
Chromium	10
Copper	2.5
Lead	5
Mercury	0.2
Nickel	40
Selenium	5
Silver	10
Thallium	10
Zinc	20

2.2.3 Air Data Evaluation

The only volatile contaminant found during the air sampling was tentatively identified as acetone. Acetone appears as a chemical of concern in other media, but the lack of an absolute identification of the acetone in air rendered the data of suspect quality for that medium. Therefore, it was not included in the baseline risk assessment.

Several inorganic substances such as arsenic, beryllium, cadmium, chromium, copper, lead, nickel, and zinc were detected in air samples collected at the site. Because no detection limits for metals in air were available, and CRDLs could not be found, the air-sample data could not be used to calculate realistic risk estimates. However, substances found in soil samples were evaluated with respect to their entrainment in air and potential inhalation.

2.2.4 Drainage Ditch Sampling

Sediment samples were also collected from the drainage ditch located along the property boundary with Air Products, Inc. Contaminants detected in these sediments were also generally found in sediments taken from the Rockaway River. This ditch is considered to be inaccessible to the average trespasser, which suggests that potential for exposure to these sediments should be almost negligible. For this reason, the potential risk due to exposure to these sediments was not specifically evaluated in this baseline risk assessment. The sampling data for the drainage ditch sediments is presented in Appendix E.

2.2.5 Tentatively Identified Compounds

The Risk Assessment Guidance for Superfund (RAGS) manual suggests that when many tentatively identified compounds (TICs) are present and it is not possible to confirm their identity, they should be included as chemicals of potential concern in the risk assessment. However, many of the TICs reported for this risk assessment lack the specificity that is needed to identify their toxicity potential (e.g., cyclohexane compounds and $C_{10}H_{22}$ isomers). Because of the lack of specific chemical identity, and the large number of "known" compounds found on-site, TICs were not included in the risk assessment.

2.2.6 Background and Detection Frequency Screening

The number of potentially site-related chemicals remaining after a review of quantification limits and blank contaminants are contained in Tables 2-1 to 2-7. Two additional screenings were conducted in an attempt to identify site-specific contaminants of concern. Screening potentially site-related contaminants allows the risk assessor to focus efforts on the more important site-related contaminants.

2.2.6.1 Comparison with Background

Background samples were collected primarily from Washington Forge Pond, an upgradient, off-site location that is just west of the L.E. Carpenter property line. Sediment and surface water samples were taken directly from the pond. Sediment samples were also taken from the Rockaway River at locations between Washington Forge Pond and the railroad right of way, and just east of the right of way. Soil samples were obtained from an embankment adjacent to the pond. No background data were available for the shallow, intermediate, or deep aquifers.

Site data for soil, river sediment, and river surface water that appear in Tables 2-4, 2-5, and 2-7, respectively, were compared with the background data that appear in Table 2-8. Contaminants that were detected at concentrations lower than background for the appropriate media are listed below. These contaminants were subsequently eliminated from further consideration for exposure through the respective associated pathways.

Soil	River Sediments	River Surface Water
Antimony	Beryllium	Copper
Arsenic	Selenium	Lead
Beryllium		Zinc
Cadmium		
Lead		
Mercury		
Selenium		
Thallium		

2.2.6.2 Detection Frequency Screening

Potential site-related contaminants were further screened based on their detection frequency. Because of the differences in media sampling, only shallow groundwater and soil contaminants could be screened by this method. Contaminants detected in these media with a frequency of 5% or less were removed from the list of potential contaminants of concern.

Based on the 5% detection frequency, a minimum of 20 samples per medium were required before a contaminant could be screened using this method.

Contaminants detected in shallow groundwater at a frequency of 5% or less include:

Carbon tetrachloride
Chlorobenzene
Heptane
Lead
n-Nitrosodiphenylamine

Contaminants detected in soil at a frequency of 5% or less include:

Acenaphthene
Acenaphthylene
Anthracene
Arochlor 1260
Chlorobenzene
4,4-DDD
4,4-DDE
1,2-Dichlorobenzene
Diethylphthalate
Fluorene
Isophorone
Naphthalene
n-Nitrosodiphenylamine
1,2,4-Trichlorobenzene
1,1,1-Trichloroethane
Trichlorothene

The final list of potential contaminants of concern by medium appears in Table 2-9.

2.3 PRESENTATION OF SAMPLE DATA

Following the data compilation, the arithmetic average and upper 95% confidence limit concentrations were calculated for each medium. Maximum concentrations were used when the variability in data caused the calculated upper 95% confidence limits to exceed the maximum concentrations encountered. The tabular information (Tables 2-1 through 2-7)

representing average and upper bound concentrations of the substances of potential concern in the various media sampled were used as the basis of the risk assessment.

2.4 REFERENCES

EPA (U.S. Environmental Protection Agency), 1989. Risk Assessment Guidance for Superfund. Human Health Evaluation Manual-Part A. Interim Final Office of Solid Waste and Emergency Response. Washington, DC. OSWER Directive 9285 7-01a.

Table 2-1
Substances of Potential Concern in Shallow Groundwater -
L.E. Carpenter Site

Substance	Frequency of Detection* (# detected/# sampled)	Concentration Range (mg/L)	Geometric Mean Concentration (mg/L)	Upper 95% Confidence Limit (mg/L)
Organics				
Bis(2-ethylhexyl) phthalate	12/30	<1.0E-02 - 6.2E+01	1.6E-01	6.2E+01
Butyl benzyl phthalate	4/30	<1.0E-02 - 3.5E-01	1.4E-02	1.7E-01
1,1-Dichloroethane	2/30	<5.0E-03 - 2.5E-01	6.0E-03	1.0E-01
1,1-Dichloroethene	2/30	<5.0E-03 - 4.6E-03	3.2E-03	3.8E-03
1,2 Dichloroethene (Total)	2/30	<5.0E-03 - 2.5E-02	4.2E-03	1.4E-02
1,2-Diethylbenzene	6/30	<1.0E-02 - 1.0E-01	9.8E-03	2.5E-02
2,4 Dimethylphenol	9/30	2.8E-03 - 1.8E-01	1.0E-02	8.0E-02
Di-n-butyl phthalate	3/30	<1.0E-02 - 1.1E-01	1.0E-02	3.6E-02
Di-n-octyl phthalate	7/30	2.8E-03 - 5.4E-01	1.4E-02	1.7E-01

*Includes both hits and J values.
Key: 1.0E-02 mg/L is an exponential expression of 0.010 mg/L.

Table 2-1
(continued)

Substance	Frequency of Detection* (# detected/# sampled)	Concentration Range (mg/L)	Geometric Mean Concentration (mg/L)	Upper 95% Confidence Limit (mg/L)
		2.6E+01	4.7E-02	2.6E+01
1-Ethyl-3-methyl-benzene	10/30	2.3E-03 - 4.2E-01	1.7E-02	4.2E-01
Isopropyl benzene	8/30	<1.0E-02 - 1.0E-01	1.3E-02	5.1E-02
Methylene chloride	5/30	<5.0E-03 - 9.7E-01	2.8E-02	9.7E-01
Naphthalene	3/30	2.2E-02 - 2.9E-03	2.5E-03	2.59E-03
n-Butylbenzene	4/30	<1.0E-02 - 2.7E-02	6.7E-03	1.1E-02
n-Decane	8/30	<1.0E-02 - 3.1E+00	2.5E-02	3.1E+00
n-Nonane	4/30	<1.0E-02 - 7.1E-01	1.4E-02	1.97E-01
Phenol	3/30	<1.0E-02 - 1.2E-01	1.0E-02	4.87E-02
Tetrachloroethene	2/30	<5.0E-03 - 4.2E-03	3.1E-03	3.57E-03
1,2,3,4-Tetramethylbenzene	4/30	<4.4E-03 - 1.2E-01	8.0E-03	2.2E-02

*Includes both hits and J values.
Key: 1.7E-03 mg/L is an exponential expression of 0.0017 mg/L.

Table 2-1
(continued)

Substance	Frequency of Detection* (# detected/# sampled)	Concentration Range (mg/L)	Geometric Mean Concentration (mg/L)	Upper 95% Confidence Limit (mg/L)
Toluene	4/30	1.1E-03 - 1.1E-01	8.1E-03	1.1E-01
1,1,1-Trichloroethane	2/30	<5.0E-03 - 3.5E-03	2.8E-03	3.0E-03
Trichloroethene	2/30	<5.0E-03 - 4.8E-03	3.3E-03	3.9E-03
1,2,3-Trimethylbenzene/ 1,2,4-Trimethylbenzene	10/30	<2.0E-02 - 4.6E-01	3.8E-02	4.1E-01
1,3,5-Trimethylbenzene	8/30	<1.0E-02 - 4.9E-01	2.3E-02	4.9E-01
Xylenes (Total)	13/30	<5.0E-03 - 1.2E+02	1.4E-01	1.2E+02
Inorganics				
Antimony	5/30	<5.0E-02 - 5.5E-01	9.2E-02	4.8E-01
Arsenic	10/30	<5.0E-03 - 3.2E-02	7.1E-03	1.8E-02
Copper	5/30	<1.0E-02 - 8.9E-02	1.2E-02	2.7E-02
Nickel	4/30	<2.0E-04 - 7.0E-02	5.5E-03	7.0E-02
Selenium	2/30	<4.0E-03 - 8.6E-03	2.7E-03	3.9E-03
Zinc	18/30	<1.0E-02 - 2.2E-01	6.5E-02	2.1E-01

*Includes both hits and J values.

Key: 1.1E-03 mg/L is an exponential expression of 0.0011 mg/L.U

Table 2-2
Substances of Potential Concern in Intermediate Groundwater -
L.E. Carpenter Site

Substance	Frequency of Detection* (# detected/# sampled)	Concentration Range (mg/L)	Geometric Mean Concentration (mg/L)	Upper 95% Confidence Limit (mg/L)
Organics				
Bis(2-ethylhexyl) phthalate	2/14	4.8E-03 - 4.1E-02	5.5E-03	3.2E-02
2,4-Dimethylphenol	1/14	<1.0E-02 - 4.1E-02	7.4E-03	2.7E-02
Ethylbenzene	1/14	<5.0E-03 - 4.5E-02	3.8E-03	3.6E-02
Xylenes (Total)	2/14	<5.0E-03 - 3.6E-01	5.1E-03	3.6E-01
Inorganics				
Arsenic	1/14	<5.0E-03 - 5.0E-03	4.0E-03	4.5E-03
Chromium	2/14	<1.0E-02 - 5.7E-02	6.2E-03 (as CR III) 8.9E-04 (as CR VI)	3.4E-02 (as CR III) 4.9E-03 (as CR VI)
Copper	6/14	<1.0E-02 - 1.5E-02	6.6E-03	1.1E-02
Nickel	4/14	<4.0E-02 - 1.0E+00	4.3E-02	1.0E+00
Selenium	2/14	<5.0E-03 - 2.5E-03	2.5E-03	2.5E-03
Zinc	7/14	<1.0E-02 - 2.3E-01	2.9E-02	2.3E-01

*Includes both hits and J values.
Key: 4.8E-03 mg/L is an exponential expression of 0.0048 mg/L.

Table 2-3
Substances of Potential Concern in Deep Groundwater -
L.E. Carpenter Site

Substance	Frequency of Detection* (# detected/# sampled)	Concentration Range (mg/L)	Geometric Mean Concentration (mg/L)	Upper 95% Confidence Limit (mg/L)
Organics				
Bis(2-ethylhexyl) phthalate	1/10	<1.0E-02 - 1.8E+00	1.4E-02	1.8E+00
1,2-Dichloroethane	1/10	1.5E-03 - 1.7E-03	1.5E-03	1.7E-03
Diethylphthalate	1/10	2.2E-03 - 2.2E-03	2.2E-03	2.2E-03
Inorganics				
Chromium	4/10	<1.0E-02 - 1.3E-02	4.6E-03 (as CR III) 6.6E-04 (as CR VI)	1.11E-02 (as CR III) 1.6E-03 (as CR VI)
Copper	4/10	<1.0E-02 - 1.3E-02	6.1E-03	1.1E-02
Lead	1/10	<5.0E-03 - 4.8E-03	2.5E-03	4.8E-03
Zinc	4/10	<1.0E-02 - 3.5E-01	2.2E-02	3.5E-01

*Includes both hits and J values.
Key: 1.0E-02 mg/L is an exponential expression of 0.010 mg/L.

Table 2-4
Substances of Potential Concern in Soil -
L.E. Carpenter Site

Substance	Frequency of Detection* (# detected/# sampled)	Concentration Range (mg/kg)	Geometric Mean Concentration (mg/kg)	Upper 95% Confidence Limit (mg/kg)
Organics				
Acetone	11/78	5.5E-03 - 8.6E+01	1.1E-01	8.6E+01
Arochlor 1254	12/31	<5.4E-02 - 1.8E+01	4.2E-01	3.28E+00
Arochlor 1260	1/31	9.0E-02 - 1.3E+01	3.1E-01	1.1E+00
Benzene	6/97	1.5E-02 - 3.4E+01	3.4E-02	3.4E+01
Bis(2-ethylhexyl) phthalate	84/95	8.4E-02 - 3.0E+04	1.4E+02	3.0E+04
Butylbenzyl phthalate	23/95	3.7E-02 - 1.4E+02	2.0E-01	4.6E+00
Chlorobenzene	4/97	1.0E-03 - 9.5E+00	2.0E-03	9.3E-03
4,4-DDD	1/31	9.0E-03 - 2.7E-01	2.8E-02	7.2E-02
4,4-DDE	1/31	<9.0E-03 - 1.5E-01	2.7E-02	6.1E-02
1,2-Dichlorobenzene	1/83	<3.4E-01 - 6.0E+01	2.4E-01	5.6E-01
Diethylphthalate	1/95	2.9E-02 - 6.0E+00	6.6E-02	2.7E-01
Di-n-butyl phthalate	12/95	6.7E-02 - 3.0E+01	2.2E-01	6.7E-01
Di-n-octyl phthalate	10/95	1.7E-01 - 5.9E+02	5.3E-01	4.1E+00
Ethylbenzene	22/97	1.0E-03 - 1.7E+03	1.3E-02	1.7E+03

*Includes both hits and J values.
Key: 5.5E-03 mg/kg is an exponential expression of 0.0055 mg/kg.

Table 2-4
(continued)

Substance	Frequency of Detection* (# detected/# sampled)	Concentration Range (mg/kg)	Geometric Mean Concentration (mg/kg)	Upper 95% Confidence Limit (mg/kg)
Organics				
Isophorone	2/95	<3.4E-01 - 1.1E+02	1.8E+00	1.0E+02
Methylene chloride	43/97	3.0E-03 - 3.1E+02	1.6E-01	3.1E+02
Methyl ethyl ketone	5/78	1.0E-03 - 9.5E+01	3.2E-03	2.5E-01
Naphthalene	2/95	1.1E-01 - 2.1E-01	1.6E-01	1.7E-01
n-Nitrosodiphenylamine	5/95	3.9E-02 - 3.2E-00	5.6E-02	1.2E-01
Polyaromatic hydrocarbons (PAHs)				
Acenaphthene	4/95	3.6E-02 - 6.0E+01	6.3E-02	3.2E-01
Acenaphthylene	1/95	1.0E-01 - 6.0E+01	1.5E-01	4.3E-01
Anthracene	5/95	4.3E-02 - 4.2E-01	4.8E-02	5.4E-02
Benzo (a) anthracene	14/95	5.0E-02 - 2.7E+01	9.7E-02	2.2E-01
Benzo(a)pyrene	15/95	4.7E-02 - 2.3E+00	8.6E-02	1.5E-01
Benzo(b)fluoranthene/ Benzo(k)fluoranthene	20/95	5.8E-02 - 1.6E+00	1.3E-01	2.8E-01
Benzo(g,h,i)perylene	11/95	4.5E-02 - 1.6E+00	8.0E-02	1.4E-01

*Includes both hits and J values.
Key: 3.4E-01 mg/kg is an exponential expression of 0.34 mg/kg.

Table 2-4
(continued)

Substance	Frequency of Detection* (# detected/# sampled)	Concentration Range (mg/kg)	Geometric Mean Concentration (mg/kg)	Upper 95% Confidence Limit (mg/kg)
Organics				
Chrysene	17/95	4.4E-02 - 2.6E+00	9.6E-02	2.1E-01
Dibenzo(a,h)anthracene	9/95	3.9E-02 - 9.5E-01	4.4E-02	5.0E-02
Fluoranthene	26/95	2.0E-02 - 4.4E+00	5.7E-02	2.3E-01
Fluorene	4/95	4.1E-02 - 6.0E+01	7.2E-02	3.5E-01
Indeno(1,2,3,c,d)pyrene	11/95	4.6E-02 - 3.7E-01	7.7E-02	1.2E-01
2-Methylnaphthalene	1/97	5.9E-02 - 5.9E-02	5.9E-02	5.9E-02
Phenanthrene	26/95	4.2E-02 - 7.0E+00	9.7E-02	2.8E-01
Pyrene	23/95	5.0E-02 - 3.9E+00	1.1E-01	2.4E-01
Tetrachloroethene	28/97	<2.0E-03 - 1.8E-02	3.3E-03	3.7E-03
Toluene	6/97	2.0E-03 - 3.7E+01	3.0E-03	1.0E-02
1,2,4-Trichlorobenzene	1/95	7.7E-02 - 6.0E+01	1.2E-01	3.8E-01
1,1,1-Trichloroethane	5/97	<5.0E-03 - 9.5E+00	5.6E-03	1.8E-02
Trichloroethene	2/97	<2.0E-03 - 2.6E-02	3.8E-03	4.8E-03
Xylenes (total)	32/97	1.0E-03 - 7.4E+03	6.4E-02	7.4E+03

Table 2-4
(Continued)

Substance	Frequency of Detection* (# detected/# sampled)	Concentration Range (mg/kg)	Geometric Mean Concentration (mg/kg)	Upper 95% Confidence Limit (mg/kg)
Chromium	50/50	6.1E+00 - 4.9E-02	1.8E+01 (as Cr III) 2.6E+00 (as Cr VI)	3.3E+01 (as Cr III) 4.7E+00 (as Cr VI)
Copper	26/50	<2.5E-02 - 2.4E+02	4.7E+01	8.9E+01
Nickel	37/50	<4.0E-02 - 8.9E+01	1.3E+01	2.1E+01
Zinc	40/50	<2.0E-02 - 2.8E-03	1.3E+02	2.6E+02
Cyanide	3/39	6.3E-01 - 1.4E+00	1.0E+00	1.4E+00

*Includes both hits and J values.
Key: 4.5E-02 mg/kg is an exponential expression of 0.045 mg/kg.

Table 2-5
Substances of Potential Concern in Stream Sediments - Rockaway River
L.E. Carpenter Site

Substance	Frequency of Detection* (#detected/#sampled)	Concentration Range (mg/kg)	Geometric Mean Concentration (mg/kg)	Upper 95% Confidence Limit (mg/kg)
Organics				
Bis(2-ethylhexyl)phthalate	6/8	2.6E+00 - 7.6E+01	6.27E+00	7.6E+01
Butyl benzyl phthalate	1/3	<4.0E-01 - 9.2E-01	5.5E-01	9.2E-01
Di-n-butyl phthalate	2/3	4.1E-02 - 2.3E+00	3.3E-01	2.3E+00
Di-n-octyl phthalate	1/7	<3.2E-01 - 2.1E+00	6.85E-01	2.1E+00
Methylene chloride	1/4	5.9E-02 - 5.9E-02	5.9E-02	5.9E-02
Methyl ethyl ketone	2/2	6.0E-03 - 5.3E-02	1.8E-02	5.3E-02
Naphthalene	2/3	<4.0E-01 - 6.9E-01	2.5E-01	6.9E-01
Polycyclic aromatic hydrocarbons (PAHs)				
Acenaphthene	3/8	<4.0E-01 - 1.3E+00	3.3E-01	7.2E-01
Acenaphthylene	1/3	<4.0E-01 - 4.9E-01	3.6E-01	4.9E-01
Anthracene	4/8	<4.0E-01 - 2.6E+00	5.3E-01	2.6E+00

* Includes both hits and J values.
Key: 2.6E+00 mg/kg is an exponential expression of 2.6 mg/kg.

Table 2-5
(continued)

Substance	Frequency of Detection* (#detected/#sampled)	Concentration Range (mg/kg)	Geometric Mean Concentration (mg/kg)	Upper 95% Confidence Limit (mg/kg)
Benzo(a)anthracene	5/8	7.1E-02 - 6.4E+00	9.1E-01	6.4E+00
Benzo(a)pyrene	5/8	5.8E-02 - 5.0E+00	8.2E-01	5.0E+00
Benzo(b)fluoranthene/ Benzo(k)fluoranthene	5/8	1.2E-01 - 8.2E+00	1.2E+00	8.2E+00
Benzo(g,h,i)perylene	3/3	5.5E-02 - 3.3E+00	6.8E-01	3.3E+00
Chrysene	5/8	9.4E-02 - 6.5E+00	1.0E+00	6.5E+00
Dibenzo(a,h)anthracene	3/3	<4.0E-01 - 1.4E+00	3.4E-01	1.4E+00
Fluoranthene	5/8	1.7E-01 - 1.4E+01	1.4E+00	1.4E+01
Fluorene	3/8	<4.0E-01 - 1.3E+00	4.7E-01	9.8E-01
Indeno(1,2,3,c,d)pyrene	4/8	4.8E-02 - 2.5E+00	5.4E-01	2.5E+00
2-Methylnapthalene	1/7	2.0E-02 - 2.0E-02	2.0E-02	2.0E-02
Phenanthrene	5/8	9.0E-02 - 1.0E+01	1.2E+00	1.0E+01
Pyrene	5/8	7.3E-02 - 1.3E+01	1.3E+00	1.3E+01
Tetrachloroethene	2/4	3.0E-03 - 1.3E-02	3.6E-03	8.8E-03

* Includes both hits and J values.
Key: 2.6E+00 mg/kg is an exponential expression of 2.6 mg/kg.

Table 2-5
(continued)

Substance	Frequency of Detection* (#detected/#sampled)	Concentration Range (mg/kg)	Geometric Mean Concentration (mg/kg)	Upper 95% Confidence Limit (mg/kg)
Toluene	2/4	3.0E-03 - 3.3E-03	3.0E-03	3.0E-03
Xylenes (total)	2/4	3.0E-03 - 1.3E-02	3.0E-03	3.0E-03
Inorganics				
Aluminum	1/3	<2.0E-01 - 2.5E+03	2.9E+00	2.5E+03
Antimony	7/7	9.5E+00 - 4.3E+02	8.4E+00	4.3E+02
Arsenic	3/3	5.2E+00 - 1.2E+01	7.9E+00	1.2E+01
Barium	1/3	<2.0E-01 - 1.0E+02	1.0E+00	1.0E+02
Cadmium	3/3	1.6E+00 - 5.0E+00	2.7E-01	5.0E+00
Calcium	1/3	<5.0E+00 - 2.0E+03	2.4E+01	2.2E+03
Chromium	3/3	2.5E+01 - 3.8E+01	2.8E+01 (as Cr III) 4.0E+00 (as Cr VI)	3.3E+01 (as Cr III) 4.8E+00 (as Cr VI)
Cobalt	1/3	<5.0E-02 - 5.3E+00	1.5E-01	5.3E+00

* Includes both hits and J values.
Key: 2.6E+00 mg/kg is an exponential expression of 2.6 mg/kg.

Table 2-5
(continued)

Substance	Frequency of Detection* (#detected/#sampled)	Concentration Range (mg/kg)	Geometric Mean Concentration (mg/kg)	Upper 95% Confidence Limit (mg/kg)
Copper	7/7	3.6E+01 - 3.9E+02	8.7E+01	3.9E+02
Iron	1/3	<1.0E-04 - 1.7E+04	3.5E+00	1.7E+04
Lead	7/7	2.0E+02 - 6.6E+02	1.8E+02	6.6E+02
Magnesium	1/3	5E+00 - 1.5E+03	2.1E+01	1.5E+03
Manganese	1/3	<1.5E-02 - 3.4E+02	2.7E-01	3.4E+02
Mercury	6/6	5.0E-01 - 2.5E+00	3.5E-01	2.5E+00
Nickel	3/3	1.6E+01 - 1.9E+01	1.7E+01	1.9E+01
Potassium	1/3	<5.0E-00 - 2.8E+02	1.2E+01	2.8E+02
Sodium	1/3	<5.0E-00 - 1.4E+02	9.6E+00	1.4E+02
Vanadium	1/3	<5.0E-02 - 1.3E+02	4.3E+01	1.3E+02
Zinc	3/3	1.4E+02 - 5.5E+02	2.6E+02	5.5E+02

* Includes both hits and J values.
Key: 2.6E+00 mg/kg is an exponential expression of 2.6 mg/kg.

Table 2-6
Substances of Potential Concern in Surface Water
L.E. Carpenter Site

Substance	Frequency of Detection* (#detected/#sampled)	Concentration Range (mg/L)	Geometric Mean Concentration (mg/L)	Upper 95% Confidence Limit (mg/L)
Inorganics				
Arsenic	2/3	2.4E-03 - 2.5E-03	2.4E-03	2.5E-03
Barium	1/3	1.1E-02 - <1.0E-01	4.8E-02	1.0E-01
Calcium	1/3	<5.0E+00 - 1.7E+01	4.8E+00	1.7E+01
Chromium	3/3	1.8E-03 - 8.0E-03	3.6E-03 (as Cr III) 5.2E-04 (as Cr VI)	7.0E-03 (as Cr III) 1.0E-03 (as Cr VI)
Iron	1/3	<1.0E-01 - 3.1E-01	9.2E-02	3.1E-01
Lead	2/3	<3.1E-03 - 8.7E-02	8.7E-03	8.7E-02
Magnesium	1/3	<5.0E+00 - 7.0E+00	3.5E+00	7.0E+00
Manganese	1/3	<1.5E-02 - 4.5E-02	1.4E-02	4.5E-02
Selenium	1/3	<3.4E-03 - 2.5E-03	2.2E-03	2.5E-03
Sodium	1/3	<5.0E-03 - 1.4E+01	4.5E+00	1.4E+01
Vanadium	1/3	<8.7E-03 - 2.5E-02	1.8E-02	2.5E-02

* Include both hits and J values.
Key: 2.4E-03 mg/L is an exponential expression of 0.0024 mg/L.

Table 2-7
Background Data for Inorganics
L.E. Carpenter Site

Potential Contaminants	Soil (mg/kg)	Stream* Sediments (mg/kg)	Surface Water* (mg/L)
Aluminum	7.69E+03		
Antimony	5.03E+00	1.45E+00	
Arsenic	1.42E+01	4.90E+00	
Barium	8.63E+01		
Beryllium	7.95E-01	3.90E-01	
Cadmium	7.28E-01	2.50E-03	
Calcium	7.86E+03		
Chromium	7.51E+00	9.90E+00	
Cobalt	9.26E+00		
Copper	2.43E+01	2.06E+01	1.67E-02
Iron	2.16E+04		
Lead	1.03E+02	5.57E+01	2.07E-02
Magnesium	3.95E+03		
Manganese	3.71E+02		
Mercury	1.03E-01		
Nickel	1.04E+01	6.50E+00	
Potassium	1.56E+03		
Selenium	8.78E-01	7.00E-01	
Silver	6.90E-01		
Sodium	1.86E+02		
Thallium	9.20E+00		
Vanadium	2.31E+01		
Zinc	1.29E+02	4.63E+01	9.64 E-02

* Values represent three samples.

Table 2-8
Contaminants of Concern
L.E. Carpenter Site

Contaminant	Groundwater			Soil	Stream Sediments-Rockaway River	Surface Water Rockaway River
	Shallow	Intermediate	Deep			
Organics						
Acetone				X		
Aroclor 1254				X		
Benzene				X		
Bis(2-ethylhexyl) phthalate	X	X	X	X	X	
Butyl-benzyl phthalate	X			X	X	
1,1-Dichloro-ethane	X					
1,2-Dichloro-ethane			X			
1,1-Dichloro-ethene	X					
1,2-Dichloro-ethene (total)	X					
1,2-Diethyl-benzene	X					
Diethyl phthalate			X			
2,4-Dimethyl-phenol	X	X				
Di-n-butyl phthalate	X			X	X	
Di-n-octyl phthlate	X			X		
Ethylbenzene	X	X		X		
1-Ethylmethylbenzene	X					
Isopropyl benzene	X					
Methylene chloride	X			X	X	
Methyl ethyl ketone				X	X	
Naphthalene	X				X	
n-Butyl-benzene	X					
n-Decane	X					
n-Nonane	X					

Table 2-8
(continued)

Contaminant	Groundwater			Soil	Stream Sediments-Rockaway River	Surface Water Rockaway River
	Shallow	Intermediate	Deep			
Polycydic aromatic hydrocarbons (PAHs)						
Acenaphthene					X	
Acenaphthylene					X	
Anthracene					X	
Benzo (a) anthracene				X	X	
Benzo (a) pyrene				X	X	
Benzo (b) fluor-anthene/Benzo (k) fluoranthene				X	X	
Benzo (g,h,i) perylene				X	X	
Chrysene				X	X	
Dibenzo (a,h) anthracene				X	X	
Fluoranthene				X	X	
Fluorene					X	
Indeno (1,2,3,c,d) pyrene				X	X	
Phenanthrene				X	X	
Pyrene				X	X	
Phenol	X					
Tetrachloroethene	X			X	X	
1,2,3,4-Tetramethyl-benzene	X					
Toluene	X			X	X	
1,1,1-Trichloroethane	X					
Trichloro-ethene	X					
1,2,3-Trimethyl-benzene/1,2,4-Trimethyl-benzene	X					

Table 2-8
(continued)

Contaminant	Groundwater			Soil	Stream Sediments-Rockaway River	Surface Water Rockaway River
	Shallow	Intermediate	Deep			
1,3,5-Trimethylbenzene	X					
Xylenes (total)	X	X		X	X	
Inorganics						
Aluminum					X	
Antimony	X				X	
Arsenic	X	X			X	X
Barium					X	X
Beryllium						
Cadmium					X	
Calcium					X	X
Chromium		X	X	X	X	X
Cobalt					X	
Copper	X	X	X	X	X	
Iron					X	X
Lead			X		X	
Magnesium					X	X
Manganese					X	X
Mercury					X	
Nickel	X	X		X	X	
Potassium					X	
Selenium	X	X				X
Sodium					X	X
Thallium						
Vanadium					X	X
Zinc	X	X	X	X	X	
Cyanide				X		

SECTION 3
HUMAN HEALTH EVALUATION EXPOSURE ASSESSMENT

3.1 CHARACTERIZATION OF EXPOSURE SETTING

3.1.1 Physical Setting

The L.E. Carpenter site is bordered to the south by the Rockaway River; to the southwest by Washington Forge Pond; to the east by Wharton Enterprises, Inc., and a drainage ditch located on the Air Products and Chemicals, Inc. property; and to the west and south by urban development. Two companies currently lease portions of the L.E. Carpenter property for use as indoor warehousing and light manufacturing.

There are approximately 2 to 3 acres of vegetative cover on the site. The majority of this vegetation is early successional herbaceous coverage with forested areas restricted primarily to the banks of the Rockaway River and along an abandoned railway bed.

The Rockaway River flows to the east-northeast. Groundwater is approximately 4 to 8 feet below the surface of the site and also flows east-northeast (see Figure 1-2).

3.1.2 Potentially Exposed Populations

Those individuals most likely to be exposed to the chemical contaminants from the L.E. Carpenter site currently include workers on the site, trespassers, and waders/swimmers in the Rockaway River. Considerations for future exposure scenarios include future workers, trespassers, waders/swimmers, and hypothetical on-site residents. Although the site is located in, historically, an industrial area, and will most likely continue to be so, it was conservatively assumed that, theoretically, a home could be built on the site at some time in the future.

3.2 IDENTIFICATION AND SELECTION OF EXPOSURE PATHWAYS

Table 3-1 and 3-2 present the exposure pathways for present and future use scenarios applicable to the L.E. Carpenter site. The rationale for the selected exposure pathways is discussed in the following text.

3.2.1 Present Use Scenarios

3.2.1.1 Air Pathway

The following narrative describes the pathways and routes of exposure by which a person could be exposed to site contaminants under current use conditions.

- Inhalation of Airborne Dust

  The L.E. Carpenter (Carpenter) site is an industrial facility that is adjacent to a residential development. As a result, exposure doses due to inhalation of windblown dust from the site must be estimated for Carpenter employees and nearby residents. The Carpenter site is also accessible to local residents since the property is not completely enclosed within a fence. Most of the property is enclosed, although the northwestern area (i.e., the area bordering Ross Street) is unfenced to allow for continued use of Building 8 as an office facility. It is that area that is accessible to trespassers as well. The presence of all-terrain-vehicle (ATV) tracks on the site supports the selection of a "trespasser" scenario. Based on the nature of the trespasser's activities, exposure factors such as body weight and inhalation rate are based on a male adolescent between 12 and 18 years of age.

3.2.1.2 Groundwater Pathway

- Drinking Water

  There are several wells including a municipal well serving a residential area located within a mile downgradient from the site. A search of publicly available sampling information did not suggest likely impact from the site (WESTON, 1991). However, in the future use scenario, risk from contaminated groundwater will be evaluated with data collected from on-site wells. Use of on-site groundwater data should provide a conservative estimate of potential risk to down-gradient, off-site well users.

Table 3-1

Present Use Exposure Pathways Applicable to L.E. Carpenter Site

Medium/Pathway	Route	Receptor
Air	Inhalation of windblown dust	Worker, trespasser and resident (adult and child)
Soil	Incidental ingestion of soil	Trespasser
	Dermal contact with soil	Trespasser
Surface Water/Sediments	Incidental ingestion of surface water/sediments from the Rockaway River	Wader/swimmer
	Dermal contact with water on Rockaway River	Wader/swimmer
	Fish ingestion/Rockaway River	Trespasser

Table 3-2

Future Use Exposure Pathways Applicable to L.E. Carpenter Site

Medium/Pathway	Route	Receptor
Air	Inhalation of windblown dust	Worker, trespasser, and resident (adult and child)
Groundwater	Ingestion of groundwater	Future resident (adult and child)
	Non-ingestion uses	Future resident (adult and child)
Soil	Incidental ingestion of soil	Worker, trespasser, and resident (adult and child)
	Dermal contact with soil	Worker, trespasser, and resident (adult and child)
Surface Water/Sediments	Incidental Ingestion of surface water/sediments from the Rockaway River	Wader/swimmer
	Dermal contact with water on Rockaway River	Wader/swimmer
	Fish ingestion/Rockaway River	Resident

3.2.1.3 Soil Pathway

- Incidental Soil Ingestion

  Since work activities are presently restricted to specific areas of the site and consist of indoor manufacturing, warehousing, and office work, incidental ingestion of soil by employees is not currently an applicable pathway. However, trespassers might participate in activities that result in soil contact. Therefore, incidental soil ingestion by a trespasser has been evaluated.

- Dust Inhalation

  Since no work is presently performed outside, the only soil contact route applicable to the current use scenario is inhalation. Inhalation of contaminated soil has also been evaluated for trespassers and nearby residents.

- Dermal Contact

  Trespassers are the only individuals exposed to soil through dermal contact since no work is presently performed outside.

3.2.1.4 Stream Sediment Pathway

- Incidental Ingestion

  The Rockaway River is a potential site for wading/swimming. It is deep enough for these activities and access is available through a railroad right-of-way. Wading/swimming will allow for contact with sediments, making the incidental ingestion of sediments plausible.

- Dermal Contact

  Because of factors described above (see stream sediment, incidental ingestion), dermal contact with stream sediments has also been evaluated for wader/swimmers.

3.2.1.5 Surface Water Pathway

- Incidental Ingestion

  Since wading/swimming is possible in the Rockaway River, incidental ingestion of surface water is considered in the present use scenario.

- Dermal Contact

  Dermal exposure to contaminants in surface water is also evaluated in the present use scenario for the wader/swimmer. Dermal contact doses are calculated since organic chemicals can be absorbed through the skin into the bloodstream. Absorption potential for most metals is negligible, so dermal contact with water containing metals will not be evaluated.

3.2.1.6 Fish Ingestion

The Rockaway River adjacent to the L.E. Carpenter site is stocked with trout by the NJDEP and contains naturally occurring populations of edible sport fish. Therefore, trespassers or local residents may be potentially exposed to contaminants through the ingestion of fish caught in the Rockaway River. Therefore, this exposure pathway will be evaluated in both the present and future use scenarios.

Fish taken from Washington Forge Pond are not included in the fish ingestion pathway. This pond would not be expected to contain any site-related substances, because it is upgradient from the site in terms of groundwater movement. Furthermore, the pond is positioned such that surface runoff from the site into the pond is unlikely. Finally, migration of fish from the Rockaway River in the vicinity of the site into the pond is prevented by a concrete barrier that forms the spillway of the pond.

Exposure to chemicals of concern in surface water through fish ingestion were restricted to those chemicals detected in surface waters above quantification limits. Those chemicals were:

- arsenic
- chromium VI (assumed)
- chromium III
- selenium

Additionally, a number of contaminants were found in sediments of Rockaway River that were not detected in the surface water samples. Because the bioavailability for fish uptake is uncertain for these chemicals, a screening analysis using equilibrium partitioning was conducted and has been included in Appendix A. Note, however, that use of the screening analysis is confined to the ecological portion of the risk assessment; no screening analysis was performed for the human health portion of the risk assessment because the risk potential of ingestion of these substances is sufficiently addressed in the consideration of risk due to direct ingestion of sediments and soils.

3.2.2 Future Use Scenarios

The future use receptors are, as previously mentioned, the worker, trespasser, and wader/swimmer that are currently exposed. At the request of NJDEP, a proposed residential on-site scenario has been included. L.E. Carpenter and Company intends to restrict future use of the site to industrial/manufacturing through the application of a deed restriction.

Since chemical toxicity is manifested at different doses in children in comparison with adults, both a child resident and an adult resident are considered for exposure.

3.2.2.1 Air Pathway

- Inhalation Offsite Routes

  As part of the future-use residential scenario, inhalation of air-borne contaminants in dust has been evaluated.

3.2.2.2 Groundwater Pathway

- Ingestion

  Under the future use scenario, a resident on-site would be using the groundwater for drinking. Therefore, the ingestion route of exposure is applicable and has been included.

- Non-ingestion Uses of Groundwater

  Hypothetical residents would be exposed to volatiles in groundwater through non-ingestion routes when the substances are vaporized and inhaled. This is possible while showering, cooking, washing dishes, etc.

3.2.2.3 Soil Pathway

- Ingestion

  Hypothetical residents doing yard work, or playing outside would be exposed directly to soil. Dermal contact with soil can lead to incidental soil ingestion through hand-to-mouth contact. Therefore, incidental soil ingestion by a resident has been evaluated.

- Inhalation

  Outside activities such as gardening and playing can stir up dust on which contaminants are adsorbed. Because these fine particles can be inhaled, the dust inhalation pathway has been evaluated, as stated earlier.

- Dermal

  Because outside activities provide the opportunity for dermal contact with soil, the soil dermal absorption pathway has been evaluated.

3.3 QUANTIFICATION OF EXPOSURE

The following Tables 3-3 through 3-12 present the algorithms, as well as the assumptions used in calculating the exposure doses received by the individuals identified as receptors in the previous section.

Appendix B contains the calculated exposure doses for subchronic and chronic daily intakes for the present and future use scenarios.

Table 3-13 presents the contaminants of concern and the Federal and New Jersey corrective action criteria for groundwater (shallow, intermediate, and deep).

A comparison with Federal and state MCLs (Maximum Contaminant Levels) indicates that several contaminants exceed standards.

Contaminants in the shallow depth wells that exceed the Federal and/or New Jersey MCLs are as follows: tetrachloroethane, and xylene exceed EPA and New Jersey regulations; 1,1-dichloroethene, 1,2-dichloroethene, and methylene chloride exceed only New Jersey regulations; ethylbenzene, and antimony exceed the Federal MCL and MCLG; nickel and selenium exceed the Federal MCL and MCLG at maximum concentrations; and trichloroethene exceeds the New Jersey MCL, and the Federal MCLG at both average and maximum concentrations, but exceeds the EPA MCL at a maximum concentration only.

Xylene exceeds the New Jersey MCL in the intermediate well depth. Copper exceeds the New Jersey MCL at the maximum concentration. Zinc exceeds the EPA MCL at the maximum concentration. Chromium, nickel and selenium exceed the EPA MCL and MCLG (nickel and selenium at maximum concentrations only). Lead is the only chemical in the deep well zone that exceeds the MCLG (zero for lead), although it does not exceed the MCL.

Bis(2-ethylhexyl) phthalate exceeds New Jersey criteria in all groundwater zones. Concentrations found in the shallow zone are approximately three orders of magnitude higher than the New Jersey groundwater protection standard.

The chemicals in Table 3-13 that NJDEP states should not exceed a total concentration of 50 μg/L have a total average concentration of 1044 μg/L in the shallow well depth. These substances are not found in intermediate or deep well depths.

Table 3-3

Ingestion of Groundwater

Equation:

$$\text{Dose (mg/kg/day)} = \frac{\text{CW} * \text{IR}}{\text{BW}}$$

Where:

CW = Contaminant Concentration in Water (mg/L)
IR = Ingestion Rate (L/day)
BW = Body Weight (kg)

Variable Values:

CW: Site-specific measured values (see Appendix B)

Present Use Assumptions:

This pathway is not of concern in present use scenarios.

Future Use Assumptions:

Resident, Adult:

IR	=	2 L/day (90th percentile water ingestion rate for adults; EPA, 1991)
BW	=	70 kg (adult, average; EPA 1991)

Resident, Child:

IR	=	1 L/day (assuming one half of the 2 L/day 90th percentile water ingestion rate for adults; EPA, 1989a)
BW	=	15 kg (average for 1-6 year olds; EPA, 1991)

Table 3-4

Non-ingestion of Groundwater Uses

Equation:

$$\text{Dose (mg/kg/day)} = \frac{\text{CW} * \text{IRCE}}{\text{BW}}$$

Where:

CW = Contaminant Concentration in Water (mg/L)
IRCE = Inhalation Rate Concentration Equivalent (L/day)
BW = Body Weight (kg)

Variable values:

CW: Site-specific measured values (see Appendix B)

Present Use Assumptions:

This pathway is not of concern in present use scenarios.

Future Use Assumptions:

Resident, Adult:

IRCE = 2 L/day (adult approximate equivalent dose of volatiles from inhalation of groundwater; Cothern et al., 1986)

BW = 70 kg (adult, average; EPA 1991)

Resident, Child:

IRCE = 1 L/day (conservatively assuming the preteen (32 kg) approximate equivalent dose of volatiles from inhalation of groundwater to be equal to the dose for a 16 kg child; Cothern et al., 1986)

BW = 15 kg (average for 1-6 year olds; EPA, 1991)

Table 3-5

Incidental Ingestion of Soil

Equation:

$$\text{Dose (mg/kg/day)} = \frac{\text{CS} * \text{SIR}}{\text{BW}}$$

Where:

CS = Contaminant Concentration in Soil (mg/kg)
SIR = Soil Ingestion Rate (kg/day)
BW = Body Weight (kg)

Variable Values:

CS: Site-specific measured values (see Appendix B)

Present Use Assumptions:

Trespasser:

SIR = 50 mg/day (5.0E-05 kg/day) (assuming that one half of the adult incidental soil ingestion daily intake of 100 mg occurs while trespassing on-site; EPA, 1991)

BW = 55.9 kg (average weight of a 12-18 year old; EPA, 1989b)

Table 3-5
(Continued)

Future Use Assumptions:

Worker: SIR = 50 mg/day (5.0E-05 kg/day) (assuming that one-half of the adult incidental soil ingestion daily intake of 100 mg occurs while working on-site; EPA, 1991)

BW = 70 kg (adult, average; EPA, 1991)

Resident, Adult:

SIR = 100 mg/day (1.00E-04 kg/day) (adult incidental soil ingestion rate, EPA, 1991)

BW = 70 kg (adult, average; EPA, 1991)

Resident, Child:

SIR = 200 mg/day (child incidental soil ingestion rate; EPA, 1991)

BW = 15 kg (average for 1-6 year olds; EPA, 1991)

Table 3-6

Inhalation of Soil Dust

Equations:

$$\text{Dose (mg/kg/day)} = \frac{CS * RD * IR}{BW}$$

Where:

CS = Contaminant Concentration in Soil (mg/kg)
RD = Respirable Dust (kg/m^3)
IR = Inhalation Rate (m^3/day)
BW = Body Weight (kg)

Variable Values:

CS = Site-specific measured values (see Appendix B)
RD = 30 $\mu g/m^3$ (3.0E-08 kg/m^3)(MADEQE, 1987)

Present Use Assumptions:

Worker:

IR = 20 m^3/day (EPA, 1991)

BW = 70 kg (adult, average; EPA, 1991)

Trespasser:

IR = 1.7 m^3/day (assuming 20 m^3/day; EPA, 1991, 2 hours/24 hours spent on-site)

BW = 55.9 kg (average weight of a 12-18 year old; EPA, 1989b)

Table 3-6
(Continued)

Future Use Assumptions:

Resident, Adult:

IR = 20 m^3/day (adult, upper bound inhalation rate; U.S. EPA, 1991)

BW = 70 kg (adult, average; EPA, 1991)

Resident, Child:

IR = 25.6 m^3/day (calculated from data for 6 year olds, assuming 8 hours at rest, 8 hours of light activity, and 8 hours of moderate activity; EPA, 1989b)

BW = 15 kg (average for 1-6 year olds; EPA, 1991)

Table 3-7

Dermal Contact with Soils

Equation:

$$\text{Dose (mg/kg/day)} = \frac{CS * SA * AF * ABS}{BW}$$

Where:

CS	=	Contaminant Concentration in Soil (mg/kg)
SA	=	Surface Area Available for Contact (cm^2/day)
AF	=	Adherence Factor (kg/cm^2)
ABS	=	Absorbance Factor (no units)
BW	=	Body Weight (kg)

Variable Values:

CS	=	Site-specific measured values (see Appendix B)
AF	=	1.45E-06 kg/cm^2 (adherence factor for commercial potting soil to the hands; EPA, 1989a)
ABS	=	Polyaromatic hydrocarbons - 2% (Yang et al., 1989) Semivolatile organics - 5% (assumed) Volatile organics and cyanide - 50% (assumed) All other inorganics - 0%

Present Use Assumptions:

Trespasser:

SA	=	3120 cm^2/day (50th percentile surface area for the arms and hands of an adult male; EPA, 1989a)
BW	=	55.9 kg (average weight of a 12-18 year old; EPA, 1989b)

Table 3-7
(Continued)

Future Use Assumptions:

Worker:

SA = 3120 cm^2/day (50th percentile surface area for the arms and hands of an adult male; EPA, 1989)

BW = 70 kg (adult, average; EPA, 1991)

Resident, Adult:

SA = 3120 cm^2/day (50th percentile surface area for the arms and hands of an adult male; EPA, 1989)

BW = 70 kg (adult, average; EPA, 1991)

Resident, Child:

SA = 3910 cm^2/day (50th percentile surface area for the arms, hands, and legs of a 6-7 year old; EPA, 1989a)

BW = 15 kg (average for 1-6 year olds; EPA, 1989b)

Table 3-8

Incidental Ingestion of Stream Sediments (Rockaway River)

Equation:

$$\text{Dose (mg/kg/day)} = \frac{\text{CSS} * \text{IR}}{\text{BW}}$$

Where:

CSS = Contaminant Concentration in Stream Sediments (mg/kg)
IR = Ingestion Rate (kg/day)
BW = Body Weight (kg)

Variable Values:

CSS = Site-specific measured values (see Appendix B)

Present Use Assumptions:

Wader/Swimmer:

IR = 2.5E-05 kg/day (assuming that one-quarter of the adult incidental soil ingestion daily intake of 100 mg occurs on site; EPA, 1991)

BW = 25 kg (average body weight for a 6-10 year old child; EPA, 1989b)

Future Use Assumptions:

The only applicable future use scenario is a continuation of present use.

Table 3-9

Dermal Contact with Stream Sediments
(Rockaway River)

Equation:

$$\text{Dose (mg/kg/day)} = \frac{\text{CSS} * \text{SA} * \text{AF} * \text{ABS}}{\text{BW}}$$

Where:

CSS = Contaminant Concentration in Stream Sediments (mg/kg)
SA = Surface Area Available for Contact (cm^2/day)
AF = Adherence Factor (kg/cm^2)
ABS = Absorbance Factor (no units)
BW = Body Weight (kg)

Variable Values:

CSS = Site-specific measured values (see Appendix B)
AF = 1.45E-06 kg/cm^2 (adherence factor for commercial potting soil to the hands; EPA, 1989a)
ABS = Polyaromatic hydrocarbons - 2% (Yang et al, 1989)
Semivolatile organics - 5% (assumed)
Volatile organics and cyanide - 50% (assumed)
All other inorganics - 0%

Present Use Assumptions:

Wader/Swimmer:

SA = 1132.7 cm^2/day (50th percentile surface area for the hands and feet of a 6-10 year old; EPA, 1989a)

BW = 25 kg (average body weight for a 6-10 year old child; EPA, 1989b)

Future Use Assumptions:

The only applicable future use scenario is a continuation of present use.

Table 3-10

Incidental Ingestion of Surface Water (Rockaway River)

Equation:

$$\text{Dose (mg/kg/day)} = \frac{\text{CSW} * \text{CR} * \text{ET}}{\text{BW}}$$

Where:

CSW = Contaminant Concentration in Stream Sediments (mg/kg)
CR = Contact Rate (L/hr)
ER = Exposure Time (hr/day)
BW = Body Weight (kg)

Variable Values:

CSW = Site-specific measured values (see Appendix B)

Present Use Assumptions:

Wader/Swimmer:

CR = 5.0E-02 L/hr (EPA, 1989a)
ET = 1 hr/day (assumed)
BW = 25 kg (average body weight for a 6-10 year old child; EPA, 1989b)

Future Use Assumptions:

The only applicable future use scenario is a continuation of present use.

Table 3-11

Dermal Contact with Surface Water (Rockaway River)

Equation:

$$\text{Dose (mg/kg/day)} = \frac{\text{CSW} * \text{SA} * \text{PC} * \text{ET} * \text{CF}}{\text{BW}}$$

Where:

CSW = Contaminant Concentration in Surface Water (mg/L)
SA = Surface Area Available for Contact (cm^2)
PC = Dermal Permeability Constant (cm/hr)
ET = Exposure Time (hr/day)
CF = Volumetric Conversion Factor (L/cm^3)
BW = Body Weight

Variable Values:

CSW = Site-specific measured values (see Appendix B)

PC = 8.00 E-04 cm/hr (the permeability of water, used as a default value; EPA, 1989a; EPA, 1988)

CF = 1 L/1000 cm^3

Present Use Assumptions:

Wader/Swimmer:

SA = 9250 cm^2 (50th percentile total body surface area for 6-9 year olds; EPA, 1989a)

ET = 1 hr/day (assumed)

BW = 25 kg (average body weight for a 6-10 year old child; EPA, 1989b)

Future Use Assumptions:

The only applicable future use scenario is a continuation of present use.

Table 3-12

Fish Ingestion

Equation:

$$\text{Dose (mg/kg/day)} = \frac{CF * IR}{BW*F}$$

Where:

CF = CSW * BCF
CF = Concentration in Fish (mg/kg)
CSW = Contaminant Concentration in Surface Water (mg/L)
BCF = Bioconcentration factor (L/kg)
IR = Human Ingestion Rate of Fish (g/day)
BW = Body Weight (kg)
F = Conversion Factor (g/kg)

Variable Values:

CSW = Site-specific measured values (see Appendix B)

BCF = Compound Specific

CF = Calculated as outlined above

F = 1000 g/kg

Present Use Assumptions:

Resident, Adult:

IR = 54 g/day (assuming one-quarter of the 50th percentile fish ingestion rate; EPA, 1991)
BW = 70 kg (adult, average; EPA, 1991)

Resident, Child:

IR = 27 g/day (assuming one-half the adult ingestion rate)

BW = 15 kg (average for 1-6 year olds; EPA, 1991)

Future Use Assumptions: The only applicable future use scenario is a continuation of present use.

Table 3-13
Comparison of Groundwater Contaminant Concentrations to MCLs

Contaminant	Geometric Mean Site Concentration (mg/L)			Upper 95% Confidence Limit (mg/L)			EPA[a]		New Jersey[b]
	Shallow Wells	Intermediate Wells	Deep Wells	Shallow	Intermediate	Deep	MCLG (mg/L)	MCL (mg/L)	MCL (mg/L)
ORGANICS									
Bis(2-ethylhexyl) phthalate	1.57E-01	5.52E-03	1.44E-02	6.2E+01	3.23E-02	1.80E+00			5.0E-03[b]
Butyl-benzyl phthalate	1.37E-02			1.66E-01					* (c)
1,1 Dichloroethane	6.00E-03			1.04E-01					* (c)
1,2-Dichloroethane			1.48E-03			1.70E-03			2E-03
1,1-Dichloroethene	3.22E-03			3.82E-03			7E-03	7E-03	2E-03
1,2-Dichloroethene (total)	4.15E-03			1.40E-02			7E-02(p)	7E-02(p)	1E-02
1,2-Diethylbenzene	9.80E-02			2.5E-02					* (c)
Diethylphthalate			2.20E-03			2.20E-03			
2,4-Dimethylphenol	1.10E-02	7.41E-03		8.00E-02	2.73E-02				* (c)
Di-n-butyl phthalate	1.03E-02			3.64E-02					* (c)

a = EPA, 1989c.
b = The source for MCLs is Stokman, S. NJ DEP Memorandum, March 20, 1989 unless otherwise footnoted.
c = Blyskun, G. NJ DEP Memorandum, October 4, 1990.
d = Secondary
(p) = Proposed
* = Combined total concentration of all values with an asterisk shall not exceed 50 µg/L.

MCLG - Maximum Contaminant Level Goal;
MCL - Maximum Contaminant Level

Table 3-13
(Continued)

Contaminant	Geometric Mean Site Concentration (mg/L)			Upper 95% Confidence Limit (mg/L)			EPA[a]		New Jersey[b]
	Shallow Wells	Intermediate Wells	Deep Wells	Shallow	Intermediate	Deep	MCLG (mg/L)	MCL (mg/L)	MCL (mg/L)
Di-n-octyl phthalate	1.38E-02			1.70E-01					* (c)
Ethylbenzene	4.66E-02	3.78E-03		2.60E+01	3.59E-02		7E-01(p)	7E-01(p)	
1-ethyl-3-methyl-benzene	1.69E-02			4.20E-01					
Isopropyl benzene	1.26E-02			5.05E-02					* (c)
Methylene chloride	2.84E-02			9.70E-01					2E-03
Naphthalene	2.53E-03			2.59E-03					
n-Butylbenzene	6.65E-03			1.05E-02					* (c)
n-Decane	2.45E-02			3.10E+00					* (c)
n-Nonane	1.36E-02			1.97E-01					* (c)
Phenol	1.05E-02			4.87E-02					* (c)
Tetrachloroethene	3.11E-03			3.57E-03			0(p)	5E-03(p)	1E-03

a = EPA, 1989c.
b = The source for MCLs is Stokman, S. NJ DEP Memorandum, March 20, 1989 unless otherwise footnoted.
c = Blyskun, G. NJ DEP Memorandum, October 4, 1990.
d = Secondary
(p) = Proposed
* = Combined total concentration of all values with an asterisk shall not exceed 50 µg/L.

MCLG - Maximum Contaminant Level Goal;
MCL - Maximum Contaminant Level

Table 3-13
(Continued)

Contaminant	Geometric Mean Site Concentration (mg/L)			Upper 95% Confidence Limit (mg/L)			EPA[a]		New Jersey[b]
	Shallow Wells	Intermediate Wells	Deep Wells	Shallow	Intermediate	Deep	MCLG (mg/L)	MCL (mg/L)	MCL (mg/L)
1,2,3,4-Tetramethyl-benzene	7.95E-03			2.17E-02					* (c)
Toluene	8.11E-03			1.10E-01			2E+00(p)	2E+00(p)	
1,1,1-Trichloroethane	2.81E-03			3.01E-03					2.6E-02
Trichloroethene	3.28E-03			3.94E-03			0	5E-03	1E-03
1,2,3-Trimethyl-benzene/1,2,4-Trimethylbenzene	3.83E-02			4.07E-01					* (c)
1,3,5-Trimethyl-benzene	2.25E-02			4.90E-01					* (c)
Xylenes (total)	1.40E-01	5.08E-03		1.20E+02	3.56E-01		1E+01(p)	1E+01(p)	4.4E-02
INORGANICS									
Antimony	9.22E-02			4.83E-01			3E-03	1E-02	
Arsenic	7.09E-03	4.02E-03		1.78E-02	4.45E-03				

a = EPA, 1989c.
b = The source for MCLs is Stokman, S. NJ DEP Memorandum, March 20, 1989 unless otherwise footnoted.
c = Blyskun, G. NJ DEP Memorandum, October 4, 1990.
d = Secondary
(p) = Proposed
* = Combined total concentration of all values with an asterisk shall not exceed 50 µg/L.

MCLG - Maximum Contaminant Level Goal;
MCL - Maximum Contaminant Level

Table 3-13
(Continued)

Contaminant	Geometric Mean Site Concentration (mg/L)			Upper 95% Confidence Limit (mg/L)			EPA[a]		New Jersey[b]
	Shallow Wells	Intermediate Wells	Deep Wells	Shallow	Intermediate	Deep	MCLG (mg/L)	MCL (mg/L)	MCL (mg/L)
Chromium		7.09E-03	5.25E-03		3.92E-02	1.27E-02	1E-01(p)	5.0E-02	
Copper	1.19E-02	6.56E-03	6.09E-03	2.65E-02	1.07E-02	1.14E-02	1.3(p)	1E+00[d]	
Lead			2.47E-03		4.75E-03		0	5.0E-02	
Nickel	5.45E-03	4.27E-02		7.01E-02	1.02E+00		1E-01	1E-01	
Selenium	2.71E-03	2.49E-03		3.94E-03	2.50E-03		5.5E-02(p)	1.0E-02	
Zinc	6.48E-02	2.94E-02	2.17E-02	2.09E-01	2.29E-01	3.50E-01		5[d]	

a = EPA, 1989c.
b = The source for MCLs is Stokman, S. NJ DEP Memorandum, March 20, 1989 unless otherwise footnoted.
c = Blyskun, G. NJ DEP Memorandum, October 4, 1990.
d = Secondary
(p) = Proposed
* = Combined total concentration of all values with an asterisk shall not exceed 50 µg/L.

MCLG - Maximum Contaminant Level Goal;
MCL - Maximum Contaminant Level

3.4 REFERENCES

Blyskun, G. 1990. Memorandum from G. Blyskun to E.G. Krup, Case Manager. Subject: Corrective Action Ground Water Criteria, L.E. Carpenter Site, Wharton, Morris County. (Dated: 4 October 1990).

Cothern, C.R., Coniglio, W.A. and W.L. Mancus. 1986. Estimating Risk to Human Health. *Science and Technology*. Vol. 20 (2):111.

EPA (U.S. Environmental Protection Agency), 1988. Superfund Exposure Assessment Manual. Office of Remedial Response. Washington, DC. OSWER Directive 9285.5-1.

EPA (U.S. Environmental Protection Agency), 1989a. Risk Assessment Guidance for Superfund. Human Health Evaluation Manual - Part A. Interim Final. Office of Solid Waste and Emergency Response. Washington, DC. OSWER Directive 9285.7-01a.

EPA (U.S. Environmental Protection Agency), 1989b. Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/8-89/043.

EPA (U.S. Environmental Protection Agency), 1989c. Drinking Water Regulations Under the Safe Drinking Water Act. Fact Sheet. Office of Drinking Water. Washington, DC. December - 1989.

EPA (U.S. Environmental Protection Agency), 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual. *Supplemental Guidance* "Standard Default Exposure Factors." Interim Final OSWER Directive 9285.6-03.

MADEQE (Massachusetts Department of Environmental Quality Engineering), 1987. *Air Quality Report*. Division of Air Quality Control. Boston, Massachusetts.

Stokman, S. 1989. Memorandum from S. Stockman to BEERA Staff. Subject: Current Federal and State Drinking, Surface, and Ground Water Standards, Criteria, and Advisories. (Dated: 20 March 1990).

USGS (U.S. Geological Survey), 1985. Water Resources Data. New Jersey. Water Year 1985.
Vol. 1. Atlantic Slope Basins. Hudson River to Cape May. USGS Water Data Report NJ-85-1.

WESTON, 1991. Well Search Within a One-Mile Radius of the L.E. Carpenter Site, Wharton, New Jersey. 27 March 1991.

Yang, R. J. Krueger, A., Neil, W., and C. Mackerer. 1989. In vitro and in vivo percutaneous absorption of benzo(a)pyrene from petroleum crude - fortified soil in the rat. *Bull. Environ. Contam. Toxicol.* 43:207.

SECTION 4
TOXICITY ASSESSMENT

4.1 INTRODUCTION

The purpose of the toxicity assessment is to identify the toxicity values (i.e., cancer slope factors and reference doses) that are used in Section 5 to evaluate the potential health risks posed by the doses that were estimated in Section 3. When available, current human health toxicity values that have been developed by the U.S. EPA (EPA) have been used. When appropriate established values were not available, they were derived from other existing toxicity values or data.

In evaluating potential health risks, both carcinogenic and noncarcinogenic health effects must be considered. Excessive exposure to all pollutants can potentially produce noncarcinogenic health effects, while the potential for carcinogenic effects is limited to exposure to certain substances. Therefore, it was necessary to identify and select noncancer toxicity values for each of the chemicals selected for evaluation and to identify and select cancer toxicity values only for those chemicals that have evidence of carcinogenicity.

4.2 CANCER SLOPE FACTORS

The toxicity values that are used in the evaluation of carcinogenic risks in Section 5 are cancer slope (i.e., potency) factors that have been developed by EPA. It is assumed by EPA in developing cancer slope factors that the risk of cancer is linearly related to dose. This means that even if all of the cancer data obtained from laboratory animals or epidemiological studies are for relatively high doses, it is conservatively assumed that these high doses can be extrapolated down to extremely small doses, with some risk of cancer remaining. This is a nonthreshold theory that assumes that even a small number of molecules (possibly even a single molecule) of a carcinogen may cause changes in a single cell that could result in the cell dividing in an uncontrolled manner and eventually lead to

cancer. The slope factors are usually derived by EPA by a linearized multistage model and usually reflect the upper-bound limit of the potency of the chemical. As a result, the calculated carcinogenic risk is likely to represent a plausible upper limit to the risk. The actual risk is unknown, but is likely to be lower than the predicted risk, and may be even as low as zero (EPA, 1986a; 1989).

With the exceptions of lead and butyl benzyl phthalate, all chemicals in this study that have evidence of carcinogenicity in animals and/or humans and are classified as carcinogens by EPA (Groups A, B, or C) and/or the International Agency for Research on Cancer (IARC) (Groups 1, 2A, or 2B) will be evaluated for potential carcinogenic risk (CIS, 1988; EPA, 1990). The chemicals that have been categorized as carcinogens and their EPA and IARC carcinogenicity classifications are presented in Table 4-1. An explanation of the EPA and IARC carcinogenicity classification systems is presented in Table 4-2.

Although lead is classified by the EPA as a carcinogen (Group B2), EPA recommends that its carcinogenicity not be quantitated for the purpose of risk assessment because of the uncertainty of its carcinogenic potency. In addition, EPA has stated that lead does not appear to be a potent carcinogen and that at low doses "the non-cancer effects of lead are of greatest concern for regulatory purposes" (EPA, 1988). There are currently no EPA-derived slope factors for lead. There are also no slope factors available for butyl benzyl phthalate, which is categorized by EPA as a Group C carcinogen. In the absence of slope factors, lead and butyl benzyl phthalate were not included in the evaluation of potential cancer risk.

The potential cancer risk posed by Polycyclic Aromatic Hydrocarbons (PAHs) will be evaluated using the following two approaches:

- The traditional EPA approach which assumes that all carcinogenic PAHs have the potency of benzo(a)pyrene (EPA, 1984a), and

- A comparative potency approach developed by ICF Clement (Clement, 1988). (Note: This is included as a part of the sensitivity analysis in Section 5.)

In assessing the carcinogenic risk posed by PAHs, EPA has, in the past, recommended the use of the slope factor for benzo(a)pyrene to estimate the risk posed by all carcinogenic PAHs (EPA, 1984a). EPA is currently reevaluating the slope factor for benzo(a)pyrene. In the absence of a published revised value, the previously developed factor (EPA, 1986b) was used for the EPA approach. Benzo(g,h,i)perylene and indeno(1,2,3-c,d)pyrene are not currently categorized as carcinogens by EPA or IARC. They were therefore not included in the EPA type assessment.

Because benzo(a)pyrene is one of the most potent of the carcinogenic PAHs, it is believed that the EPA approach described above will result in an overestimate of risk due to PAHs. ICF-Clement has recently developed, under contract to EPA, a comparative approach in which the carcinogenic PAHs are assigned relative potency estimates.

These potency estimates can be used to calculate compound-specific slope factors from the slope factors for benzo(a)pyrene. Benzo(g,h,i)perylene and indeno(1,2,3-c,d)pyrene will be included in the evaluation of cancer risk because Clement has assigned a relative potency factor for each. This relative potency approach is still under review by EPA.

The carcinogenic potency of a substance depends, in part, on its route of entry into the body (e.g., oral, inhalation, or dermal). Therefore, slope factors are developed and classified according to the route of administration. EPA has developed oral and/or inhalation slope factors for some carcinogens (EPA, 1990). Dermal slope factors have not been derived for any chemicals. The slope factors that are used in this evaluation are discussed, by exposure route, in the following subsections.

Table 4-1

EPA and IARC Categorizations of the Carcinogenic Pollutants

Pollutant	EPA Carcinogenicity Category	IARC Carcinogenicity Category
Organics		
Arochlor 1254	B2(a)	2A(a)
Benzene	A	1
Benzo(a)anthracene	B2	2A
Benzo(a)pyrene	B2	2A
Benzo(b)fluoranthene	B2	2B
Benzo(k)fluoranthene	B2	2B
Bis(2-ethylhexyl)phthalate	B2	2B
Butylbenzyl phthalate	C(b)	3
Chrysene	B2	3
Dibenzo(a,h)anthracene	B2	2A
1,1-Dichloroethane	C	NL
1,2-Dichloroethane	B2	2B
1,1-Dichloroethene	C	NL
Indeno(1,2,3-c,d)pyrene	B2	2B
Methylene chloride	B2	2B
Tetrachloroethene	B2	2B
Trichloroethene	B2	3
Inorganics		
Arsenic	A	1
Beryllium	B1	2A
Cadmium	B1(c)	2A
Chromium (VI)	A(c)	1
Lead	B2	2B
Nickel	A(c)	1

(a) Classification is for polychlorinated biphenyls.
(b) Classification is for oral route only.
(c) Classification is for inhalation route only.

Table 4-2

EPA and IARC Categorizations of Carcinogens Based on Human and Animal Evidence

EPA Categorization of Carcinogens (EPA, 1986b)

	Animal Evidence				
	Sufficient	Limited	Inadequate	No Data	No Evidence
Human Evidence					
Sufficient	A	A	A	A	A
Limited	B1	B1	B1	B1	B1
Inadequate	B2	C	D	D	D
No data	B2	C	D	D	E
No evidence	B2	C	D	D	E

Key:

Group A - Human carcinogen (sufficient evidence from epidemiological studies).

Group B1 - Probable human carcinogen (at least limited evidence of carcinogenicity to humans).

Group B2 - Probable human carcinogen (a combination of sufficient evidence in animals and inadequate data in humans).

Group C - Possible human carcinogen (limited evidence in animals in the absence of human data).

Group D - Not classified (inadequate animal and human data).

Group E - No evidence for carcinogenicity (no evidence for carcinogenicity in at least two adequate animal tests in different species, or in both epidemiological and animal studies).

Table 4-2
(Continued)

IARC Categorization of Carcinogens (WHO, 1987)

Group 1 - Human carcinogen (sufficient evidence of carcinogenicity in humans).

Group 2A - Probable human carcinogen (limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals).

Group 2B - Possible human carcinogen (limited evidence of carcinogenicity in humans and insufficient evidence of carcinogenicity in experimental animals; insufficient evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals; or insufficient evidence of carcinogenicity in humans and limited evidence of carcinogenicity in experimental animals, with supporting evidence from other relevant data).

Group 3 - Not classifiable (substances in this category do not fall into any other category).

Group 4 - Probably not carcinogenic to humans.

4.2.1 Oral Route

As previously noted, the carcinogenic potency of a chemical depends on its route of entry into the body. In some cases, a carcinogen may produce tumors only at or near a specific natural route of entry (e.g., nasal passages), and may not be carcinogenic through other exposure routes. This applies to several of the evaluated inorganic pollutants, including cadmium, chromium VI, and nickel (EPA, 1990). Therefore, cancer risk was not calculated for these metals through the oral route. Oral slope factors, expressed in units of $(mg/kg/day)^{-1}$ and/or unit risk factors, expressed in units of $(\mu g/L)^{-1}$, were available for the remaining evaluated carcinogens. A slope factor was calculated from the unit risk factor, in accordance with EPA guidance (EPA, 1990), if a slope factor was unavailable.

4.2.2 Inhalation Route

The carcinogenic potency of inhalation carcinogens can be presented as a slope factor expressed in units of $(mg/kg/day)^{-1}$, or as a unit risk factor expressed in units of $(\mu g/m^3)^{-1}$. These values can be interconverted in accordance with EPA guidance by taking into consideration the inhalation of 20 m^3(air)/day and a body weight of 70 kg (EPA, 1990). In Subsection 5.1.1, the potency of inhalation carcinogens expressed as the slope factor (i.e., $(mg/kg/day)^{-1}$) will be used in conjunction with the estimated daily intakes, calculated as administered dose, in estimating cancer risk.

Inhalation slope factors were available for most of the carcinogens selected for evaluation (EPA, 1990). For the few organics for which an inhalation slope factor was unavailable, the oral slope factor was used to evaluate the inhalation pathway.

The inhalation slope factor for nickel refinery dust was used to evaluate the risk posed by nickel through the inhalation pathway. EPA has developed inhalation slope factors for nickel as nickel subsulfide and as refinery dust. The form in which nickel is present in the sampled media is not known but is expected to vary. The composition of refinery dust also

varies, depending on the process, but can include both nickel sulfides and oxides. Because refinery dust can contain several forms of nickel, the inhalation slope factor for nickel refinery dust was used in preference to the slope factor for nickel subsulfide.

4.2.3 Dermal Route

Although few data are available concerning the carcinogenic activity of chemicals that are systemically absorbed through dermal exposure, it is assumed that chemicals that are carcinogenic through the oral route are potentially carcinogenic through the dermal route, provided that the substances can penetrate skin. Metals are assumed to have no absorption potential through skin and are not evaluated for carcinogenic potential as a result of dermal exposure. All carcinogenic organic substances are considered to be capable of penetrating skin to at least a limited extent and are evaluated for carcinogenic potential via the dermal route.

In the absence of dermal slope factors for all of the carcinogens, a dermal slope factor was derived for each chemical, in accordance with EPA guidance, by dividing its respective oral slope factor by an appropriate gastrointestinal absorption factor (EPA, 1989). As a result, each dermal slope factor represents the potency of the absorbed dermal dose. This is consistent with the approach described in Subsection 3.3 for calculating intake through dermal exposure, in which the estimated daily intake is expressed as an absorbed dermal dose.

Ideally, each oral slope factor should be adjusted by a gastrointestinal absorption factor that corresponds specifically to the test species/strain and the vehicle that were used in the study(ies) on which the oral slope factor was based. These data were either lacking for most of the chemicals or were, at best, limited. Therefore, assumptions were made regarding the gastrointestinal absorption of each of the chemicals, depending on their general chemical classification: volatile organic or semi-volatile organic. The assumptions were based on available information for substances which fall into these categories and are expected to be

conservative. Gastrointestinal absorption factors of 90 percent (0.90) and 50 percent (0.50) were assumed for volatile organics and semi-volatile organics. It should be noted that the lower the gastrointestinal absorption factor, the more conservative the toxicity value that is derived.

Oral toxicity values for volatile organics are commonly based on data from oral studies in which the agent is administered in drinking water or by gavage, or are extrapolated from inhalation toxicity studies. Absorption through these routes would be expected to be close to or at 100 percent. Assuming the possibility of less than total absorption, a gastrointestinal absorption factor of 0.90 was used for volatile organics. Oral toxicity values for semi-volatile organics are usually derived from oral studies in which the agent is administered in the diet, by gavage, or by capsule. In a few cases, they may also be developed from inhalation data. Semi-volatile organics are also expected to be well absorbed (i.e., 50 percent or greater). A gastrointestinal absorption factor of 50 percent was assumed for the semi-volatiles. This value probably best approximates absorption through dietary exposure, and is likely to be conservative for the other vehicles (i.e., gavage and capsule).

4.2.4 Summary

The slope factors for the carcinogenic pollutants are presented in Table 4-3. The reference or basis for each of the slope factors is provided.

4.3 REFERENCE DOSES

Unlike the approach used in evaluating cancer risk, for noncarcinogenic health effects it is assumed that a threshold dose exists below which there is no potential for toxicity. The toxicity values used to evaluate the potential for noncarcinogenic health effects are generically referred to in this document as reference doses (RfDs). The term RfD was developed by EPA to refer to a daily intake of a chemical to which an individual can be exposed without any expectation of noncarcinogenic adverse health effects occurring (e.g.,

TABLE 4-3 TOXICITY VALUES

CHEMICAL	INGESTION					
	CARCINOGENIC SLOPE FACTOR	REFERENCE OR BASIS	SUBCHRONIC ORAL REFERENCE DOSE	REFERENCE OR BASIS	CHRONIC ORAL REFERENCE DOSE	REFERENCE OR BASIS
	(mg/kg/day)-1		(mg/kg/day)		(mg/kg/day)	
ORGANICS						
Acetone	NA		1.00E-01	CORD	1.00E-01	EPA, 1990
Aroclor 1254	7.70E+00	EPA, 1990	7.00E-05	EPA, 1990 (a)	7.00E-06	EPA, 1990 (a)
Benzene	2.90E-02	EPA, 1990	1.00E-02	Derived	1.00E-03	Derived
Bis(2-ethylhexyl) phthalate	1.40E-02	EPA, 1990	2.00E-02	EPA, 1990	2.00E-02	EPA, 1990
Butyl-benzyl phthalate	ND		2.00E+00	EPA, 1990	2.00E-01	EPA, 1990
1,1-Dichloroethane	9.10E-02	EPA, 1990 (b)	1.00E+00	EPA, 1990	1.00E-01	EPA, 1990
1,2-Dichloroethane	9.10E-02	EPA, 1990	7.40E-03	CORD	7.40E-03	Derived
1,1-Dichloroethene	6.00E-01	EPA, 1990	9.00E-03	EPA, 1990	9.00E-03	EPA, 1990
1,2-Dichloroethene (total)	NA		2.00E-01	EPA, 1990	2.00E-02	EPA, 1990
1,2-Diethylbenzene	NA		5.00E-02	CORD	5.00E-02	Derived
Diethylphthalate	NA		8.00E+00	EPA, 1990	8.00E-01	EPA, 1990
2,4-Dimethylphenol	NA		2.00E-01	EPA, 1990	2.00E-02	EPA, 1990
Di-n-butyl phthalate	NA		1.00E+00	EPA, 1990	1.00E-01	EPA, 1990
Di-n-octyl phthlate	NA		2.00E-02	EPA, 1990	2.00E-02	EPA, 1990
Ethylbenzene	NA		1.00E+00	EPA, 1990	1.00E-01	EPA, 1990
1-ethyl-3-methylbenzene	NA		5.00E-02	CORD	5.00E-02	Derived
Isopropyl benzene (cumene)	NA		4.00E-01	EPA, 1990	4.00E-02	EPA, 1990
Methylene chloride	7.50E-03	EPA, 1990	6.00E-02	EPA, 1990	6.00E-02	EPA, 1990
Methyl ethyl ketone	NA		5.00E-01	EPA, 1990	5.00E-02	EPA, 1990
Naphthalene	NA		4.00E-03	EPA, 1990	4.00E-03	EPA, 1990
n-Butylbenzene	NA		5.00E-02	CORD	5.00E-02	Derived
n-Decane	NA		2.10E-01	CORD	2.10E-01	Derived
n-Nonane	NA		1.07E+00	CORD	1.07E+00	CIRD

TABLE 4-3 TOXICITY VALUES

CHEMICAL	INGESTION					
	CARCINOGENIC SLOPE FACTOR	REFERENCE OR BASIS	SUBCHRONIC ORAL REFERENCE DOSE	REFERENCE OR BASIS	CHRONIC ORAL REFERENCE DOSE	REFERENCE OR BASIS
	(mg/kg/day)-1		(mg/kg/day)		(mg/kg/day)	
Polycyclic aromatic hydrocarbons (PAHs)						
Acenaphthene	NA		6.00E-01	EPA, 1990	6.00E-02	EPA, 1990
Acenaphthylene	NA		3.00E-01	EPA, 1990 (c)	3.00E-02	EPA, 1990 (c)
Anthracene	NA		3.00E+00	EPA, 1990	3.00E-01	EPA, 1990
Benzo (a) anthracene	1.15E+01	EPA, 1986 (d)	3.00E-01	EPA, 1990 (c)	3.00E-02	EPA, 1990 (c)
	4.67E-01	Clement, 1988 (e)	----	----	----	----
Benzo(a)pyrene	1.15E+01	EPA, 1986	3.00E-01	EPA, 1990 (c)	3.00E-02	EPA, 1990 (c)
	3.22E+00	Clement, 1988	----	----	----	----
Benzo(b)fluoranthene/Benzo(k)fluoranthene	1.15E+01	EPA, 1986 (d)	3.00E-01	EPA, 1990 (c)	3.00E-02	EPA, 1990 (c)
	4.50E-01	Clement, 1988	----	----	----	----
Benzo(g,h,i)perylene	7.08E-02	Clement, 1988	3.00E-01	EPA, 1990 (c)	3.00E-02	EPA, 1990 (c)
Chrysene	1.15E+01	EPA, 1986 (d)	3.00E-01	EPA, 1990 (c)	3.00E-02	EPA, 1990 (c)
	1.42E-02	Clement, 1988	----	----	----	----
Dibenzo(a,h)anthracene	1.15E+01	EPA, 1986 (d)	3.00E-01	EPA, 1990 (c)	3.00E-02	EPA, 1990 (c)
	3.57E+00	Clement, 1988	----	----	----	----
Fluoranthene	NA		4.00E-01	EPA, 1990	4.00E-02	EPA, 1990
Fluorene	NA		4.00E-01	EPA, 1990	4.00E-02	EPA, 1990
Indeno(1,2,3,c,d) pyrene	1.15E+01	EPA, 1986 (d)	3.00E-01	EPA, 1990 (c)	3.00E-02	EPA, 1990 (c)
	7.47E-01	Clement, 1988	----	----	----	----
2-Methylnaphthalene	NA		3.00E-01	EPA, 1990 (c)	NA	
Phenanthrene	NA		3.00E-01	EPA, 1990 (c)	3.00E-02	EPA, 1990 (c)
Pyrene	2.60E-01	Clement, 1988	3.00E-01	EPA, 1990	3.00E-02	EPA, 1990
Phenol	NA		6.00E-01	EPA, 1990	6.00E-01	EPA, 1990
Tetrachloroethene	5.10E-02	EPA, 1990	1.00E-01	EPA, 1990	1.00E-02	EPA, 1990
1,2,3,4-Tetramethylbenzene	NA		6.40E-02	CORD	6.40E-02	Derived
Toluene	NA		4.00E-01	EPA, 1990	3.00E-01	EPA, 1990
1,1,1-Trichloroethane	NA		9.00E-01	EPA, 1990	9.00E-02	EPA, 1990
Trichloroethene	1.10E-02	EPA, 1990	7.35E-03	CORD	7.35E-03	EPA, 1987
1,2,3-Trimethylbenzene/1,2,4-Trimethylbenzene	NA		5.00E-02	CORD	5.00E-02	Derived
1,3,5-Trimethylbenzene	NA		5.00E-02	CORD	5.00E-02	Derived
Xylenes (total)	NA		4.00E+00	EPA, 1990	2.00E+00	EPA, 1990

TABLE 4-3 TOXICITY VALUES

CHEMICAL	INGESTION					
	CARCINOGENIC SLOPE FACTOR	REFERENCE OR BASIS	SUBCHRONIC ORAL REFERENCE DOSE	REFERENCE OR BASIS	CHRONIC ORAL REFERENCE DOSE	REFERENCE OR BASIS
	(mg/kg/day)-1		(mg/kg/day)		(mg/kg/day)	
INORGANICS						
Aluminum	NA		1.93E-02	CORD	1.93E-02	CORD
Antimony	NA		4.00E-04	EPA, 1990	4.00E-04	EPA, 1990
Arsenic	1.75E+00	EPA, 1990 (f)	1.00E-03	EPA, 1990	1.00E-03	EPA, 1990
Barium	NA		5.00E-02	EPA, 1990	5.00E-02	EPA, 1990
Beryllium	4.30E+00	EPA, 1990	5.00E-03	EPA, 1990	5.00E-03	EPA, 1990
Cadmium	NA		(food) 1.00E-03	CORD	(food) 1.00E-03	EPA, 1990
	NA		(water) 5.00E-03	CORD	(water) 5.00E-03	EPA, 1990
Calcium	NA		1.14E+01	CORD	1.14E+01	Derived
Chromium III	NA		1.00E+01	EPA, 1990	1.00E+00	EPA, 1990
Chromium VI	NA		2.00E-02	EPA, 1990	5.00E-03	EPA, 1990
Cobalt	NA		2.30E-03	CORD	2.30E-03	Derived
Copper	NA		3.70E-02	EPA, 1990	3.70E-02	EPA, 1990 (g)
Iron	NA		2.57E-01	CORD	2.57E-01	Derived
Lead	ND		ND		ND	
Magnesium	NA		5.70E+00	CORD	5.70E+00	Derived
Manganese	NA		5.00E-01	EPA, 1990	5.00E-01	EPA, 1990
Mercury	NA		3.00E-04	EPA, 1990 (h)	3.00E-04	EPA, 1990 (h)
Nickel	NA		2.00E-02	EPA, 1990	2.00E-02	EPA, 1990
Potassium	NA		8.00E+00	CORD	8.00E+00	Derived
Selenium	NA		3.00E-03	EPA, 1990 (b)	3.00E-03	EPA, 1990 (b)
Sodium	NA		4.70E+01	CORD	4.70E+01	Derived
Thallium	NA		7.00E-04	EPA, 1990	7.00E-05	EPA, 1990
Vanadium	NA		7.00E-03	EPA, 1990	7.00E-03	EPA, 1990
Zinc	NA		2.00E-01	EPA, 1990	2.00E-01	EPA, 1990
Cyanide	NA		2.00E-02	EPA, 1990	2.00E-02	EPA, 1990

TABLE 4-3 TOXICITY VALUES

CHEMICAL	INHALATION					
	CARCINOGENIC SLOPE FACTOR	REFERENCE OR BASIS	SUBCHRONIC INHALATION REFERENCE DOSE	REFERENCE OR BASIS	CHRONIC INHALATION REFERENCE DOSE	REFERENCE OR BASIS
	(mg/kg/day)-1		(mg/kg/day)		(mg/kg/day)	
ORGANICS						
Acetone	NA		1.82E+00	CIRD	1.82E+00	ACGIH - TWA
Aroclor 1254	7.70E+00	OSF	5.10E-04	CIRD	5.10E-04	ACGIH - TWA
Benzene	2.90E-02	EPA, 1990	1.00E-02	SCORD	1.00E-03	CORD
Bis(2-ethylhexyl) phthalate	1.40E-02	OSF	5.10E-03	CIRD	5.10E-03	ACGIH - TWA
Butyl-benzyl phthalate	ND		2.00E+00	SCORD	2.00E-01	CORD
1,1-Dichloroethane	9.10E-02	OSF	1.00E+00	EPA, 1990	1.00E-01	EPA, 1990
1,2-Dichloroethane	9.10E-02	EPA, 1990	4.08E-02	CIRD	4.08E-02	ACGIH - TWA
1,1-Dichloroethene	1.20E+00	EPA, 1990	4.08E-03	CIRD	4.08E-03	OSHA - TWA
1,2-Dichloroethene (total)	NA		8.06E-01	CIRD	8.06E-01	OSHA - TWA
1,2-Diethylbenzene	NA		5.00E-02	SCORD	5.00E-02	CORD
Diethylphthalate	NA		5.10E-03	CIRD	5.10E-03	ACGIH - TWA
2,4-Dimethylphenol	NA		2.00E-01	SCORD	2.00E-02	CORD
Di-n-butyl phthalate	NA		5.10E-03	CIRD	5.10E-03	ACGIH - TWA
Di-n-octyl phthlate	NA		2.00E-02	SCORD	2.00E-02	CORD
Ethylbenzene	NA		4.43E-01	CIRD	4.43E-01	ACGIH - TWA
1-ethyl-3-methylbenzene	NA		5.00E-02	SCORD	5.00E-02	CORD
Isopropyl benzene (cumene)	NA		9.00E-02	EPA, 1990	9.00E-03	EPA, 1990
Methylene chloride	1.40E-02	EPA, 1990	8.57E-01	EPA, 1990 (i)	8.57E-01	EPA, 1990 (i)
Methyl ethyl ketone	NA		9.00E-01	EPA, 1990	9.00E-02	EPA, 1990
Naphthalene	NA		5.10E-02	CIRD	5.10E-02	OSHA - TWA
n-Butylbenzene	NA		5.00E-02	SCORD	5.00E-02	CORD
n-Decane	NA		2.10E-01	SCORD	2.10E-01	CORD
n-Nonane	NA		1.07E+00	CIRD	1.07E+00	ACGIH - TWA

TABLE 4-3 TOXICITY VALUES

CHEMICAL	INHALATION					
	CARCINOGENIC SLOPE FACTOR	REFERENCE OR BASIS	SUBCHRONIC INHALATION REFERENCE DOSE	REFERENCE OR BASIS	CHRONIC INHALATION REFERENCE DOSE	REFERENCE OR BASIS
	(mg/kg/day)-1		(mg/kg/day)		(mg/kg/day)	
Polycyclic aromatic hydrocarbons (PAHs)						
Acenaphthene	NA		6.00E-01	SCORD	6.00E-02	CORD
Acenaphthylene	NA		3.00E-01	SCORD	3.00E-02	CORD
Anthracene	NA		3.00E+00	SCORD	3.00E-01	CORD
Benzo (a) anthracene	6.10E+00	EPA, 1986 (d)	3.00E-01	SCORD	3.00E-02	CORD
	6.57E-02	Clement, 1988	----	----	----	----
Benzo(a)pyrene	6.10E+00	EPA, 1986	3.00E-01	SCORD	3.00E-02	CORD
	4.53E-01	Clement, 1988	----	----	----	----
Benzo(b)fluoranthene/Benzo(k)fluoranthene	6.10E+00	EPA, 1986 (d)	3.00E-01	SCORD	3.00E-02	CORD
	6.34E-02	Clement, 1988	----	----	----	----
Benzo(g,h,i)perylene	9.97E-03	Clement, 1988	3.00E-01	SCORD	3.00E-02	CORD
Chrysene	6.10E+00	EPA, 1986 (d)	3.00E-01	SCORD	3.00E-02	CORD
	1.99E-03	Clement, 1988	----	----	----	----
Dibenzo(a,h)anthracene	6.10E+00	EPA, 1986 (d)	3.00E-01	SCORD	3.00E-02	CORD
	5.03E-01	Clement, 1988	----	----	----	----
Fluoranthene	NA		4.00E-01	SCORD	4.00E-02	CORD
Fluorene	NA		4.00E-01	SCORD	4.00E-02	CORD
Indeno(1,2,3,c,d) pyrene	6.10E+00	EPA, 1986 (d)	3.00E-01	SCORD	3.00E-02	CORD
	1.05E-01	Clement, 1988	----	----	----	----
2-Methylnaphthalene	NA		NA		NA	
Phenanthrene	NA		3.00E-01	SCORD	3.00E-02	CORD
Pyrene	3.67E-02	Clement, 1988	3.00E-01	SCORD	3.00E-02	CORD
Phenol	NA		1.94E-02	CIRD	1.94E-02	ACGIH - TWA
Tetrachloroethene	3.30E-03	EPA, 1990	1.73E-01	CIRD	1.73E-01	OSHA - TWA
1,2,3,4-Tetramethylbenzene	NA		6.40E-02	SCORD	6.40E-02	CORD
Toluene	NA		5.71E-01	EPA, 1990 (I)	5.71E-01	EPA, 1990 (I)
1,1,1-Trichloroethane	NA		3.00E+00	EPA, 1990	3.00E-01	EPA, 1990
Trichloroethene	1.70E-02	EPA, 1990	2.74E-01	CIRD	2.74E-01	ACGIH - TWA
1,2,3-Trimethylbenzene/1,2,4-Trimethylbenzene	NA		1.26E-01	CIRD	1.26E-01	ACGIH - TWA
1,3,5-Trimethylbenzene	NA		1.26E-01	CIRD	1.26E-01	ACGIH - TWA
Xylenes (total)	NA		8.57E-02	EPA, 1990 (I)	8.57E-02	EPA, 1990 (I)

TABLE 4-3 TOXICITY VALUES

CHEMICAL	INHALATION					
	CARCINOGENIC SLOPE FACTOR	REFERENCE OR BASIS	SUBCHRONIC INHALATION REFERENCE DOSE	REFERENCE OR BASIS	CHRONIC INHALATION REFERENCE DOSE	REFERENCE OR BASIS
	(mg/kg/day)-1		(mg/kg/day)		(mg/kg/day)	
INORGANICS						
Aluminum	NA		NC		NC	
Antimony	NA		5.10E-04	CIRD	5.10E-04	ACGIH - TWA
Arsenic	1.51E+01	EPA, 1990 (j)	2.04E-04	CIRD	2.04E-04	ACGIH - TWA
Barium	NA		NC		NC	
Beryllium	8.40E+00	EPA, 1990	2.04E-06	CIRD	2.04E-06	ACGIH - TWA
Cadmium	6.10E+00	EPA, 1990	5.10E-05	CIRD	5.10E-05	ACGIH - TWA (k)
	------		------		------	
Calcium	NA		NC		NC	
Chromium III	NA		5.10E-04	CIRD	5.10E-04	ACGIH - TWA
Chromium VI	4.10E+01	EPA, 1990	5.10E-05	CIRD	5.10E-05	ACGIH - TWA
Cobalt	NA		NC		NC	
Copper	NA		1.02E-03	CIRD	1.02E-03	ACGIH - TWA (l)
Iron	NA		NC		NC	
Lead	ND		ND		ND	
Magnesium	NA		NC		NC	
Manganese	NA		NC		NC	
Mercury	NA		8.57E-05	EPA, 1990 (h,l)	8.57E-05	EPA, 1990 (h,l)
Nickel	8.40E-01	EPA, 1990 (m)	1.02E-04	CIRD	1.02E-04	ACGIH - TWA (n)
Potassium	NA		NC		NC	
Selenium	NA		2.04E-04	CIRD	2.04E-04	ACGIH - TWA
Sodium	NA		NC		NC	
Thallium	NA		1.02E-04	CIRD	1.02E-04	ACGIH - TWA
Vanadium	NA		NC		NC	
Zinc	NA		4.10E-03	CIRD	4.10E-03	OSHA - TWA (o)
Cyanide	NA		5.10E-03	CIRD	5.10E-03	ACGIH - TWA

TABLE 4-3 TOXICITY VALUES

CHEMICAL	DERMAL (p)			
	CLASS (q)	CARCINOGENIC SLOPE FACTOR (mg/kg/day)-1	SUBCHRONIC DERMAL REFERENCE DOSE (mg/kg/day)	CHRONIC DERMAL REFERENCE DOSE (mg/kg/day)
ORGANICS				
Acetone	V	NA	9.00E-02	9.00E-02
Aroclor 1254	SV	1.54E+01	3.50E-05	3.50E-06
Benzene	V	3.22E-02	9.00E-03	9.00E-04
Bis(2-ethylhexyl) phthalate	SV	2.80E-02	1.00E-02	1.00E-02
Butyl-benzyl phthalate	SV	NA	1.00E+00	1.00E-01
1,1-Dichloroethane	V	1.01E-01	9.00E-01	9.00E-02
1,2-Dichloroethane	V	1.01E-01	6.66E-03	6.66E-03
1,1-Dichloroethene	V	6.67E-01	8.10E-03	8.10E-03
1,2-Dichloroethene (total)	V	NA	1.80E-01	1.80E-02
1,2-Diethylbenzene	SV	NA	2.50E-02	2.50E-02
Diethylphthalate	SV	NA	4.00E+00	4.00E-01
2,4-Dimethylphenol	SV	NA	1.00E-01	1.00E-02
Di-n-butyl phthalate	SV	NA	5.00E-01	5.00E-02
Di-n-octyl phthlate	SV	NA	1.00E-02	1.00E-02
Ethylbenzene	V	NA	9.00E-01	9.00E-02
1-ethyl-3-methylbenzene	SV	NA	2.50E-02	2.50E-02
Isopropyl benzene (cumene)	SV	NA	2.00E-01	2.00E-02
Methylene chloride	V	8.33E-03	5.40E-02	5.40E-02
Methyl ethyl ketone	V	NA	4.50E-01	4.50E-02
Naphthalene	SV	NA	2.00E-03	2.00E-03
n-Butylbenzene	SV	NA	2.50E-02	2.50E-02
n-Decane	SV	NA	1.05E-01	1.05E-01
n-Nonane	SV	NA	5.35E-01	5.35E-01

TABLE 4-3 TOXICITY VALUES

CHEMICAL	DERMAL (p)			
	CLASS (q)	CARCINOGENIC SLOPE FACTOR (mg/kg/day)-1	SUBCHRONIC DERMAL REFERENCE DOSE (mg/kg/day)	CHRONIC DERMAL REFERENCE DOSE (mg/kg/day)
Polycyclic aromatic hydrocarbons (PAHs)				
Acenaphthene	SV	NA	3.00E-01	3.00E-02
Acenaphthylene	SV	NA	1.50E-01	1.50E-02
Anthracene	SV	NA	1.50E+00	1.50E-01
Benzo (a) anthracene	SV	2.30E+01 9.34E-01	1.50E-01	1.50E-02
Benzo(a)pyrene	SV	2.30E+01 6.44E+00	1.50E-01	1.50E-02
Benzo(b)fluoranthene/Benzo(k)fluoranthene	SV	2.30E+01 9.00E-01	1.50E-01	1.50E-02
Benzo(g,h,i)perylene	SV	1.42E-01	1.50E-01	1.50E-02
Chrysene	SV	2.30E+01 2.84E-02	1.50E-01	1.50E-02
Dibenzo(a,h)anthracene	SV	2.30E+01 7.14E+00	1.50E-01	1.50E-02
Fluoranthene	SV	NA	2.00E-01	2.00E-02
Fluorene	SV	NA	2.00E-01	2.00E-02
Indeno(1,2,3,c,d) pyrene	SV	2.30E+01 1.49E+00	1.50E-01	1.50E-02
2-Methylnaphthalene	SV	NA	1.50E-01	NA
Phenanthrene	SV	NA	1.50E-01	1.50E-02
Pyrene	SV	5.20E-01	1.50E-01	1.50E-02
Phenol	SV	NA	3.00E-01	3.00E-01
Tetrachloroethene	V	5.67E-02	9.00E-02	9.00E-03
1,2,3,4-Tetramethylbenzene	SV	NA	3.20E-02	3.20E-02
Toluene	V	NA	3.60E-01	2.70E-01
1,1,1-Trichloroethane	V	NA	4.50E-01	4.50E-02
Trichloroethene	V	1.22E-02	6.62E-03	6.62E-03
1,2,3-Trimethylbenzene/1,2,4-Trimethylbenzene	SV	NA	2.50E-02	2.50E-02
1,3,5-Trimethylbenzene	SV	NA	2.50E-02	2.50E-02
Xylenes (total)	V	NA	3.60E+00	1.80E+00

TABLE 4-3 TOXICITY VALUES

CHEMICAL	DERMAL (p)			
	CLASS (q)	CARCINOGENIC SLOPE FACTOR (mg/kg/day)-1	SUBCHRONIC DERMAL REFERENCE DOSE (mg/kg/day)	CHRONIC DERMAL REFERENCE DOSE (mg/kg/day)
INORGANICS				
Aluminum	I	NC	NC	NC
Antimony	I	NC	NC	NC
Arsenic	I	NC	NC	NC
Barium	I	NC	NC	NC
Beryllium	I	NC	NC	NC
Cadmium	I	NC	NC	NC
	I	NC	NC	NC
Calcium	I	NC	NC	NC
Chromium III	I	NC	NC	NC
Chromium VI	I	NC	NC	NC
Cobalt	I	NC	NC	NC
Copper	I	NC	NC	NC
Iron	I	NC	NC	NC
Lead	I	NC	NC	NC
Magnesium	I	NC	NC	NC
Manganese	I	NC	NC	NC
Mercury	I	NC	NC	NC
Nickel	I	NC	NC	NC
Potassium	I	NC	NC	NC
Selenium	I	NC	NC	NC
Sodium	I	NC	NC	NC
Thallium	I	NC	NC	NC
Vanadium	I	NC	NC	NC
Zinc	I	NC	NC	NC
Cyanide	I	NA	1.00E-02	1.00E-02

TABLE 4-3 TOXICITY VALUES

ACGIH - TWA = American Conference of Governmental Industrial Hygienists - Time-Weighted Average
CIRD = Chronic inhalation reference dose
CORD = Chronic oral reference dose
I = Inorganic
NA = Not applicable
NC = Not of concern. Chemical is not of concern through this exposure route.
ND = Not determined
OSF = Oral slope factor
OSHA - TWA = Occupational Safety and Health Administration - Time-Weighted Average
SCORD = Subchronic oral reference dose
SV = Semi-volatile
V = Volatile

(a) RfD for polybrominated biphenyls (PBBs) was used.
(b) Value is from the update for quarters 1 and 2. There was no value listed in the third quarter update.
(c) RfD for pyrene, the most conservative RfD available for a structurally similar PAH, was used.
(d) Potency factor is for benzo (a) pyrene. See text section 4.
(e) Value is for benzo (a) anthracene, which is the more potent of the two carcinogens.
(f) Calculated form a recommended unit risk, expressed as (ug/L)-1, assuming the ingestion of 2 liters of water/day and a body weight of 70 kg.
(g) Calculated from a proposed MCL (EPA, 1990), assuming the ingestion of 2 liters of water/day and a body weight of 70 kg (see Subsection 3.3).
(h) RfD is for inorganic mercury, the only available RfD for mercury.
(i) Converted from the RfD in mg/m3 assuming an inhalation rate of 20 m3/day and a body weight of 70 kg.
(j) Calculated from the unit risk factor (EPA, 1990), assuming an inhalation rate of 20 m3/day and a body weight of 70 kg (see Subsection 3.3).
(k) Based on cadmium dusts and salts
(l) Based on copper dusts and mists
(m) The value is for nickel refinery dusts
(n) Based on nickel refinery dust
(o) Based on zinc oxide dust, respirable fraction, adjusting for percentage of zinc.
(p) Dermal toxicity values were calculated from the oral toxicity values (see Section 4).
(q) The classification of each chemical was used in the selection of the gastrointestinal absorption factor which was needed in the derivation of the dermal slope factors and dermal reference doses for the volatile organics (V), semi-volatile organics (SV), and inorganics (I). (See Section 4).

organ damage, biochemical alterations, birth defects). The term is used in this assessment to apply to any established or derived toxicity value fitting this description. In general terms, the RfD is derived from a NOAEL (no-observed-adverse-effect level) or LOAEL (lowest-observed-adverse-effect level) by the application of standard order-of-magnitude uncertainty factors, and an additional modifying factor which accounts for professional assessment of scientific uncertainties in the available data (EPA, 1989).

Reference doses (RfDs), like cancer slope factors, are developed for specific exposure routes. In addition, separate RfDs are derived to evaluate chronic exposure (defined by EPA as seven years or longer) and subchronic exposure periods (defined by EPA as 2 weeks to seven years) (EPA, 1989). In this risk assessment, subchronic RfDs will be used to evaluate the trespasser scenario. Chronic and subchronic RfDs have been derived by EPA for a number of chemicals for the oral and/or inhalation routes, but have not been developed for the dermal route for any chemicals. The oral RfDs that are used in this evaluation are discussed, by exposure route, in the following subsections.

4.3.1 Oral Route

4.3.1.1 Chronic

Current chronic oral RfDs were available for the majority of the pollutants being evaluated through the oral exposure route. For the remaining pollutants, either an RfD for a closely related chemical was used, an old oral RfD was used, the chronic inhalation RfD was used, or an RfD was derived from available toxicity data, a health standard, or nutritional information. Chronic oral RfDs were derived for numerous chemicals. The approaches used in deriving these RfDs are presented in Appendix C.

4.3.1.2 Subchronic

Where available, EPA-derived subchronic oral RfDs were used. In some cases, the subchronic oral RfD of a closely related chemical was used. For the remaining chemicals,

with the exceptions of benzene, the chronic oral RfD was adopted, by default, as the subchronic RfD. In general, this is a conservative approach because chronic RfDs are usually lower (and never higher) than the corresponding subchronic RfDs. For benzene, a subchronic oral RfD was derived based on available toxicity data. The approach to deriving the oral subchronic RfD for benzene is presented in Appendix C.

4.3.2 Inhalation Route

4.3.2.1 Chronic

EPA-derived chronic inhalation RfDs were available for only a relative few of the chemicals. In the absence of a chronic inhalation RfD, an inhalation RfD was calculated, where possible, based on an occupational exposure limit (OEL) The occupational exposure limits that were considered included the American Conference of Industrial Hygienists (ACGIH) threshold limit value-time weighted average (TLV-TWA) (ACGIH, 1990) and the Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) (DOL, 1989).

It is recognized that there are several factors that limit the usefulness of occupational guidelines in the derivation of RfDs. OELs are intended to protect healthy workers from adverse health effects when exposed to a chemical in the workplace over a 40-hour work week. Inhalation RfDs are intended to protect the general population, including sensitive subpopulations, based on a continuous exposure. Furthermore, OELs are derived by consensus as opposed to a procedure that incorporates standard uncertainty factors according to the nature of the toxicological database from which the RfD is derived. OELs also may be based on toxic endpoints other than chronic noncarcinogenic health effects. In consideration of the limitations of the OELs, an equation was developed to derive inhalation RfDs from OELs, incorporating uncertainty factors to account for potential continuity of exposure and variability in human sensitivity. In addition, the data and/or toxic endpoint for each of the applicable OELs were reviewed to ensure that the OEL was suitable to serve as the basis for a chronic inhalation RfD (ACGIH, 1986; CDC, 1988). For

each chemical, the most conservative OEL that has been developed, and which is based on or protective against noncarcinogenic effects, was used to derive the inhalation RfD. The equation and assumptions that were used to calculate inhalation RfDs from OELs are presented in Table 4-4. The approach is consistent with EPA guidelines for deriving an RfD from a NOAEL (EPA, 1989). The equation calculates a daily dose to an exposed worker, normalized over a 7-day exposure period (i.e., the NOAEL), and adjusts the dose by an uncertainty factor of 10 to take into account human variability and a modifying factor of 10 to account for continuous daily exposure.

For the remaining pollutants for which neither chronic inhalation RfDs nor OELs were available (these included only organics), the chronic oral RfD was used, by default, as the chronic inhalation RfD.

4.3.2.2 Subchronic

Where available, EPA-derived subchronic inhalation RfDs were used. For the remaining chemicals, either the chronic inhalation RfD or the value used as the subchronic oral RfD was used, by default. The chronic inhalation RfD was used in cases where the chronicinhalation RfD was derived from an OEL. The subchronic oral RfD was used in cases in which OELs were unavailable and , therefore, the chronic oral RfD had been used as the chronic inhalation RfD.

Table 4-4

Approach to Deriving an Inhalation Reference Dose (RfD) from an Occupational Exposure Limit (OEL)

$$\text{Inhalation RfD (mg/kg/day)} = \frac{\text{OEL (mg/cu m)} \times \text{Air breathed per work day } (m^3/\text{day}) \times \text{Work week adjustment factor}}{\text{Body weight (kg)} \times \text{Uncertainty factor}}$$

Where:

Inhalation RfD	=	Inhalation reference dose.
OEL	=	Occupational exposure limit.
Air breathed per work day	=	10 m^3. This value has been used by EPA when deriving an inhalation-acceptable chronic intake (AIC) for the public from worker exposure levels (EPA, 1984).
Work week adjustment factor	=	5 days/7 days. Because the OEL is based on a 5-day work week, an adjustment was made to average the dose over a 7-day week.
Body weight	=	70 kg (weight of an average adult) (EPA, 1989).
Uncertainty factor	=	100. A factor of 10 is recommended by the EPA when deriving RfDs from human data to to account for human variation (i.e., to protect sensitive members of the general population (e.g., children and the elderly) (EPA, 1989). An additional modifying factor of 10 was included to take into account a continuous exposure for a resident (versus an intermittent exposure for a worker) and a lifetime exposure for a resident (versus a less than lifetime exposure for a worker). Uncertainty factors of 10 to 100 are commonly used by government agencies when deriving public health criteria from OELs (EPA, 1984b; MDNR, 1989; PAMS, 1983).

4.3.3 Dermal Route

As in the case of cancer slope factors, no RfDs have been developed for the dermal route. Therefore, dermal RfDs were derived for the chemicals of concern in accordance with EPA guidelines (EPA, 1989). Chronic and subchronic dermal RfDs were derived by multiplying the values used as the chronic and subchronic oral RfDs, respectively, by appropriate gastrointestinal absorption factors. In general, the gastrointestinal absorption factors were selected according to the approach described in Subsection 4.2.3 (i.e., 0.90 for volatile organics, 0.50 for semi-volatile organics). An absorption factor of 50 percent (0.50) was used for cyanide. Limited data for the gastrointestinal absorption of cyanide in humans indicate that approximately 45 to 75 percent of water soluble cyanide salts is absorbed (ATSDR, 1988).

4.4 SUMMARY

The RfDs that were used in the evaluation of noncarcinogenic risk are presented in Table 4-3. The source or basis of each of the RfDs is also indicated. Note that no RfD was derived for lead. The evaluation of lead in soil and water will be performed qualitatively by comparing the upperbound concentrations found on the site with current U.S. EPA criteria of 15 μg/L (1.5E-02 mg/L, EPA, 1990) for water and 500-1000 mg/kg in soil (EPA, 1989). Both criteria are directed toward protection of children (the sensitive population) from development of learning disabilities as a result of continued exposure to lead during the early years of childhood.

4.5 REFERENCES

ACGIH (American Conference of Governmental Industrial Hygienists), 1986. *Documentation of the Threshold Limit Values and Biological Exposure Indices*, 5th ed., ACGIH, Cincinnati, OH. (including updated supplements).

ACGIH (American Conference of Governmental Industrial Hygienists), 1990. *1990-1991 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices*. ACGIH, Cincinnati, OH.

ATSDR (Agency for Toxic Substances and Disease Registry), 1988. *Toxicological Profile for Cyanide.* Draft. Prepared by Technical Resources, Inc. for ATSDR and U.S. EPA. Published by Oak Ridge National Laboratory.

CDC (Centers for Disease Control), 1988. NIOSH Recommendations for Occupational Safety and Health Standards. MMWR: 37 (suppl. no. S-7).

CIS (Chemical Information System), 1988. *Suspect Chemicals Sourcebook Database.* Source List 9e; International Agency for Research on Cancer (IARC). Human Carcinogens, Source Lists 9F and 9G; International Agency for Research on Cancer (IARC). Animal Carcinogens.

Clement (ICF-Clement Associates), 1988. Comparative Potency Approach for Estimating the Cancer Risk Associated with Exposure to Mixtures of Polycyclic Aromatic Hydrocarbons. Interim Final Report. ICF-Clement Associates. Fairfax, Virginia.

DOL (U.S. Department of Labor), 1989. Occupational Safety and Health Administration, Code of Federal Regulations (29 CFR Part 1910). Air Contaminants. *Fed. Reg.* 54(12):2332. January 19, 1989.

EPA (U.S. Environmental Protection Agency), 1984a. *Health Effects Assessment for Polycyclic Aromatic Hydrocarbons (PAHs).* Final Draft. Environmental Criteria and Assessment Office. Cincinnati, Ohio. ECAO-CIN-HO13.

EPA (U.S. Environmental Protection Agency), 1984b. *Health Effects Assessment for Selenium (and Compounds).* Revised Final Draft. Environmental Criteria and Assessment Office. Cincinnati, OH. ECAO-CIN-H013.

EPA (U.S. Environmental Protection Agency), 1986a. "Guidelines for Carcinogenic Risk Assessment." *Federal Register.* 51(185):33992.

EPA (U.S. Environmental Protection Agency), 1986b. *Superfund Public Health Evaluation Manual.* Office of Emergency and Remedial Response. EPA 540.1-86/060.

EPA (U.S. Environmental Protection Agency), 1987. *Health Advisories for 25 Organics.* Office of Drinking Water. PB87-235578.

EPA (U.S. Environmental Protection Agency), 1988. Drinking Water Regulations; Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper. 40 CFR Parts 141 and 142. *Fed. Reg.* 53(160):31516.

EPA (U.S. Environmental Protection Agency), 1989a. Memorandum Concerning Lead Concentration in Soil. OSWER Directive 9355.4-02.

EPA (U.S. Environmental Protection Agency), 1989b. *Risk Assessment Guidance for Superfund. Human Health Evaluation Manual - Part A.* Interim Final Office of Solid Waste and Emergency Response. Washington, DC. OSWER Directive 9285.7-01a.

EPA (U.S. Environmental Protection Agency), 1990a. *Health Effects Assessment Summary Tables.* Third Quarter FY 1990. Office of Solid Waste and Emergency Response. Washington, DC. OERR 9200.6-303-(90-3).

EPA (U.S. Environmental Protection Agency), 1990b. Memorandum from Henry Longest, Director OERR and Bruce Diamond, Director OWPE, titled *Cleanup Level for Lead in Groundwater.* Date of Memorandum, June 21, 1990.

MDNR (Michigan Department of Natural Resources), 1989. "Final Report of the Air Toxics Policy Committee - A Proposed Strategy for Processing Air Quality Permit Applications for New Emission Sources of Toxic Air Pollutants."

NAS (National Academy of Sciences), 1980. *Drinking Water and Health*, Volume 3. National Academy Press, Washington, DC.

PAMS (Philadelphia Air Management Services), 1983. "Recommended Air Quality Guidelines for Toxic Air Contaminants."

WHO (World Health Organization), 1987. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Supplement 7. WHO Publications Center. Albany, NY.

SECTION 5
RISK CHARACTERIZATION

This section of the baseline risk assessment presents the calculated carcinogenic and noncarcinogenic risks based on the estimated daily intakes calculated in Section 3.3 and Appendix B, and the toxicity values presented in Table 4-3. As previously described, the total lifetime carcinogenic risk for the site is calculated for both present and future use scenarios. Under the present use scenario, carcinogenic and noncarcinogenic risk is evaluated for both a worker at the facility and a trespasser on facility property. The future use condition assumes the possibility of residential development of the site, and therefore, the risk is evaluated for both an adult and child resident.

As part of the baseline risk assessment, the NJDEP requested that an analysis of the site data be conducted to determine if there were areas on the site with concentrations of substances that were clearly evaluated above those in other areas. The intent of the analysis was to determine whether discrete areas of the site warranted separate consideration of risk potential. This entails a comparison of contaminant concentrations of individual areas of contamination with those of the overall site to determine whether specific areas need special attention for clean-up. Groundwater and soils media have sufficient data to run the analysis. Upon an evaluation of these media, it was concluded that only minor differences in contaminant concentrations occurred among discrete areas of the site; consequently, no areas of clearly elevated concentrations were identified and no separate risk analysis was warranted. The absence of discrete areas warranting separate risk assessments does not imply that subsequent evaluation of remedial alterations will ignore measures that can be implemented on discrete areas of the site. The analysis performed for the risk assessment simply involved evaluation of the need for separate risk assessments and not the potential for use of differing remedial alterations on discrete areas of the site. Refer to Appendix D for tables and full discussion of this analysis.

The following narrative presents a discussion of the methods by which carcinogenic and noncarcinogenic risks were calculated and a summary of the results.

5.1 EVALUATION OF CARCINOGENIC RISK

The risk of cancer from exposure to a chemical is described in terms of the probability that an individual exposed for an entire lifetime (70 yrs.) will develop cancer. The carcinogenic risk, then, is a function of the estimated average daily intake over a lifetime (i.e., chronic daily intake; CDI) and the cancer slope factor (SF) for the chemical of concern. The average daily intakes for appropriate routes of exposure are summarized for each chemical of concern in Subsection 3.3 and Appendix B. Since lifetime average daily doses are used in determining carcinogenic risk, cancer slope factors are based on average lifetime (i.e., 70 yrs.) exposure. To account for exposure to site contaminants of a duration less than a lifetime, the estimated lifetime daily dose requires an exposure duration adjustment (EDA).

Under the present use scenario, workers were assumed to spend 5 days/week, 50 weeks/yr, for 25 years at a job on site; therefore an exposure duration was accounted for and the lifetime average daily dose was adjusted accordingly. Similarly, the trespasser exposure adjustment was based on the expected time spent on site, which was 1 day/week, 6 months/year, for 6 years of a 70 year lifetime.

In the future use scenario for resident exposures, carcinogenic risk was calculated based on the assumption that the resident is spending 30 years in one house, located within the site boundary. This represents 6 years of exposure as a child and 24 years exposure as an adult; therefore, exposure durations of 6/70 years and 24/70 years were used to calculate child and adult carcinogenic risk, respectively. Exposure duration considered in the child wader/swimmer scenario was based on the assumption that the child swims or wades in Rockaway River one day per week during the warmer months of the year (May through September). As a result, the exposure duration adjustment for the wader swimmer was 1 day/week, 6 months/year, 6 years/70 year lifetime.

Carcinogenic risk is calculated as presented in the following equation:

$$\text{Risk} = \text{CDI} \times \text{SF} \times \text{EDA}$$

Where:

Risk	=	Probability of an individual developing cancer;
CDI	=	Chronic daily intake averaged over a lifetime (70 years) (mg/kg-day)
SF	=	Slope Factor $(mg/kg\text{-}day)^{-1}$
EDA	=	Exposure Duration Adjustment

Note that slope factors for the individual carcinogens evaluated in this assessment were previously provided in Section 4.2. Using this equation and employing the CDI values in Appendix B, and the slope factors in the previous section, the cancer risks were calculated for each of the pathways and contaminants appropriate to both the present and future use scenarios. Results of this analysis are presented in Section 5.3.

5.2 EVALUATION OF NONCARCINOGENIC RISK

Noncarcinogenic risks are evaluated by comparing contaminant-specific predicted daily intakes through each route of exposure to the appropriate reference doses (RfDs) found in Section 4 for each of the chemicals of concern. The risk of adverse noncarcinogenic effects from contaminant exposure is expressed in terms of Hazard Quotients (HQ) and Hazard Indices (HI). A hazard quotient for a particular pollutant through a given exposure route is the ratio of the predicted daily intake and the applicable RfD, as shown in the following equation:

$$HQ = DI/RfD$$

Where:

HQ = Hazard quotient.

DI = Daily intake (mg/kg/day).

RfD = Reference dose (mg/kg/day).

These hazard quotients are summed to determine the hazard index for each exposure route and for each pollutant. A total exposure hazard index is calculated by summing the hazard indices for all pollutants through all exposure routes. It is important to note that this methodology, unlike the methodology used in the evaluation of carcinogenic risk in Subsection 5.1, does not predict the relative probabilities of adverse effects occurring. If a hazard quotient or hazard index exceeds one, it simply indicates that there may be a potential for noncarcinogenic health effects occurring under the defined exposure conditions. Because RfDs incorporate a margin of safety, exceeding a criterion does not necessarily indicate that an adverse effect will occur. All RfDs were previously presented in Table 4-3. It is also important to note that all pollutants, both carcinogens and noncarcinogens, are evaluated for their potential noncarcinogenic effects.

5.3 RESULTS

The following narrative presents the results of the carcinogenic and noncarcinogenic risk characterization for the present and future use exposure scenarios defined previously in Section 3.

5.3.1 Present Use Scenarios

The following narrative presents the results of the carcinogenic risk characterization for present use for each of the pathways of exposure. Results are summarized in Tables 5-1 to 5-7 for the worker, trespasser, and wader/swimmer scenarios.

5.3.1.1 Carcinogenic Risk

Soil Pathway

Estimates of potential carcinogenic risk associated with soil contamination at the site for both the worker and trespasser scenarios are provided in Tables 5-1 through 5-4.

The total potential lifetime cancer risk to workers from exposure to contaminants in soil (which includes ingestion, inhalation, and dermal exposures) in workers is 1 in one-hundred thousand (1E-05) and 8 in ten-thousand (8E-04) at the average and upper 95% confidence limit concentrations, respectively (Tables 5-1 and 5-2). For trespassers (Tables 5-3 and 5-4), the total excess carcinogenic risk from exposure to contaminants in soil is 4 in ten-million (4E-07) and 3 in one-hundred thousand (3E-05). For both the worker and the trespasser, dermal exposure to soil contributes 90% to total risk. Aroclor 1254 and bis(2-ethylhexyl) phthalate (DEHP) contribute 95% of the risk through the soil pathway. Other substances such as PAHs, benzene, and methylene chloride in soil also contributed to risk greater than one excess cancer per million persons when considered alone (i.e., independently of other substances).

Sediments Pathway - Rockaway River

Estimates of excess lifetime carcinogenic risk due to the exposure of waders and swimmers to sediments in the Rockaway River is presented in Table 5-5 and 5-6. Carcinogenic risk posed to the waders or swimmers due to the incidental ingestion of sediments in the Rockaway River is estimated as 4 per ten-million and 2 per one-million (4E-07 and 2E-06) (average and upper 95% confidence limit concentration based numbers, respectively). Dermal absorption of contaminants from sediments represents a risk of 9 in ten-million and 6 in one-million (9E-07 and 6E-06) (based on the average and upper 95% confidence limit concentrations, respectively).

The carcinogenic risk potential due to exposure of waders and swimmers to sediments in the Rockaway River in the vicinity of the facility is fairly evenly distributed among several polycyclic aromatic hydrocarbons including benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene, as well as DEHP and arsenic.

Surface Water Pathway - Rockaway River

Incidental ingestion of arsenic (the only carcinogen found in surface water) by waders and swimmers in the Rockaway River in the vicinity of the site, results in a potential cancer risk of about 5 in one-hundred million (5E-08) based on average arsenic levels in surface water and 5 in one-hundred million (5E-08) based on upper 95% confidence limit concentrations. (Tables 5-5 and 5-6).

Dermal contact with arsenic by waders and swimmers in the Rockaway River results in a potential cancer risk of about 2 in ten million (2E-07) based on both average and upper 95% confidence limit concentrations in surface water.

Fish Ingestion

Total lifetime carcinogenic risk due to fish consumption (by both the child and adult) is provided in Table 5-7 (average and upper 95% confidence limit respectively). Based on the surface water concentrations of carcinogens found in the Rockaway River, total lifetime carcinogenic risk for child and adult exposure combined is estimated as 6 in ten-thousand (6E-04) for both average and upper 95% confidence limit concentrations. Arsenic, as stated earlier, was the only identified carcinogenic substance present in surface water. The risk estimate is based on consumption of a large amount (54 g/day) of fish caught from the river. It was further assumed that consumption occurred daily over a 30-year period. The Rockaway River in the area of the site is used by local residents for fishing but it is highly unlikely that anyone has eaten, or will eat, such a large amount of fish from the river.

Summary of Total Carcinogenic Risk for Workers and Trespassers

Tables 5-1 through 5-4 summarize the potential lifetime carcinogenic risk for workers and trespassers through the various pathways and routes of exposure. Total lifetime carcinogenic risk for the worker exposed to site contaminants through the various pathways described above ranged from about 1 in one-hundred thousand (1E-05) for the average contaminant concentrations to 8 in ten-thousand (8E-04) for upper 95% confidence limit contaminant levels. The route of exposure and contaminants providing the greatest contribution to potential risk to the worker include the dermal absorption of Aroclor 1254 and DEHP in soil. For the trespasser, the potential lifetime carcinogenic risk due to exposure to site contaminants was estimated to range from 4 in ten-million (4E-07) based on average contaminant levels to 3 in one-hundred thousand (3E-05) based on upper 95% confidence limit contaminant levels. As with the worker, the route of exposure providing the greatest contribution of risk to the trespasser included dermal exposure to Aroclor 1254 and DEHP in soils. Note that surface soils are defined in this risk assessment as being the top eight feet. As a practical matter, a worker or trespasser would rarely experience exposure to subsurface concentrations.

5.3.1.2 Noncarcinogenic Risk

Soil Pathway

Estimates of the noncarcinogenic risk to workers and trespassers due to exposure to contaminated soil are provided in Tables 5-8 through 5-11.

Total soil exposure hazard indices exceed unity (>1) for both workers and trespassers only from upper 95% confidence limit site contaminant concentrations. Both the ingestion and dermal exposure routes had hazard indices greater than unity. Upper 95% confidence limit site concentrations for DEHP, Aroclor 1254, and benzene result in greater than unity hazard indices through dermal absorption for the worker. The upper 95% confidence limit concentration for DEHP also results in a greater than unity hazard index through ingestion

for the worker. For the trespasser, the upper 95% confidence limit concentration of DEHP produced hazard indices greater than unity through both incidental ingestion and dermal contact.

Sediments Pathway - Rockaway River

Estimates of noncarcinogenic risk to swimmers and waders from exposure to sediments in the Rockaway River are provided in Tables 5-12 and 5-13. For sediment exposure, the hazard index for incidental ingestion based on the upper 95% confidence limit site concentration is greater than one (1.34E+00). This hazard index is primarily due to ingestion of antimony (1.07E+00 for antimony alone).

While the noncancer hazard index was calculated as exceeding the minimum level of concern, it must be noted that it barely exceeded that minimum level of concern. Further, it is important to note that a conservative assumption of ingestion of one-fourth the amount of soil ingested due to sediments exposure. It is not likely that the average child playing in the Rockaway River would ingest the amount of sediments assumed in this risk assessment because the river in the area of the site has an appreciable current and a rocky bottom. It is doubtful that the minimum risk level for antimony would actually be exceeded.

It is noted that the average and upper bound concentrations of lead in sediments collected in the Rockaway River were 180 mg/kg and 655 mg/kg. There are no currently accepted toxicity criteria for lead in sediments, although EPA has used a soil concentration of 500-1,000 mg/kg as a range for evaluation of need for cleanup of the soil (see Section 4). From a human exposure perspective, lead in sediments could be contacted through ingestion while children play in shallow water. Since a child would be expected to ingest sediments far less frequently than soil, the level of lead used for evaluation of soil should be conservative. Because the reasonable maximum concentration of lead in sediments falls within the lower end of the soil lead target level and because a child would not be expected to be exposed

chronically to sediments, there is little concern that direct contact with sediments poses a hazard potential to humans.

Surface Water

Tables 5-12 and 5-13 present the hazard index for wader/swimmer exposure to contaminants in the Rockaway River. The hazard indices calculated for the wader/swimmer based on both average and upper 95% confidence limit concentrations do not exceed unity (1.0) for either the dermal or incidental ingestion routes.

Fish Consumption

The noncarcinogenic risk to adults and children consuming fish from the Rockaway River is presented in Table 5-14. Based on the estimated fish tissue concentration provided in Section 3, the total hazard index for adults is estimated at 6.7E-01 and 7.0E-01 (average and upper 95% confidence limit) and for the child, 1.57 and 1.62 (average and upper 95% confidence limit). Arsenic in the surface water contributed essentially all of the noncarcinogenic risk, or 97% and 95% of the total risk for the average and upper 95% confidence limit concentrations. Again, it is important to note that very conservative estimates of ingestion (i.e., 54 g/day over a 30-year period) were used in calculation of doses received and that it is unlikely that any person actually uses the river to the maximum extent modeled here.

Summary of Total Noncarcinogenic Risk for Workers and Trespassers

Tables 5-8 through 5-11 summarize the noncarcinogenic risk for workers and trespassers through the various routes of exposure. Total noncarcinogenic risk for the worker exposed to site contaminants through the pathways described above is represented by hazard indices ranging from 0.5 to 16.4 for average and upper 95% confidence limit concentrations, respectively. The routes and pollutants contributing the greatest noncarcinogenic risk to the

workers include dermal absorption of Aroclor 1254, DEHP, and benzene. For the trespasser scenario, the potential noncarcinogenic risk (as measured by the hazard index) due to the exposure to site contaminants range from 0.1 to 14.5. The greatest contribution to noncarcinogenic risk to the trespasser included dermal absorption of Aroclor 1254 and DEHP.

5.3.2 Future Use Scenarios

This section of the risk characterization describes the potential carcinogenic and noncarcinogenic risk under a future use scenario as required by NJDEP. The future use necessarily considers residential development of the site, although the site likely will remain industrial. As such, receptors for the future use include child and adult residents on-site. L.E. Carpenter intends to prevent future use of the property for residential purposes through application of a deed restriction.

5.3.2.1 Carcinogenic Risk

The following narrative presents the results of the carcinogenic risk characterization for the future use scenario. The results of this evaluation are summarized in Table 5-15 for the adult and child risks.

Soil Pathway

Estimates of the carcinogenic risk associated with soil contamination at the site for the future resident scenario are provided in Tables 5-15 and 5-16.

The total lifetime carcinogenic risk (childhood plus adult exposure) to potential residents on the site from exposure to soil contaminants is 6 in one-hundred thousand (6E-05) and 3 in one-thousand (3E-03), for average and upper 95% confidence limit contaminant levels. Approximately 77% of the predicted risk associated with this pathway results from the

dermal absorption of contaminants from soil. The following table presents the chemical-specific risk as well as the percentage contribution to total risk, through the dermal route of exposure.

Dermal Risk (Soil)

Chemical	Average Risk (% total)	Upper 95% Confidence Limit Risk (% total)
Aroclor 1254	1.76E-05 (42)	1.38E-04 (5)
Benzene	-	3.01E-05 (1)
Bis(2-ethylhexyl)phthalate	1.05E-05 (25)	2.29E-03 (89)
Methylene chloride	-	7.05E-05 (3)
PAHs	1.33E-05 (32)	2.61E-05 (1)

Chemicals exceeding the one in one million risk due to incidental ingestion of soil at the average contaminant levels include:

- Aroclor 1254 (5.27E-06, or 29% of ingestion risk).
- Bis(2-ethylhexyl) phthalate (3.14E-06 or 17% of ingestion risk).
- Carcinogenic polycyclic aromatic hydrocarbons (PAHs) (9.99E-06 or 54% of ingestion risk).

Chemicals exceeding the one in one million risk due to ingestion of soil at the upper 95% confidence limit contaminant levels include:

- Aroclor 1254 (4.12E-05 or 5% of ingestion risk).
- Benzene (1.62E-06 or 0.2% of ingestion risk).
- Bis(2-ethylhexyl) phthalate (6.86E-04 or 91% of ingestion risk).
- Methylene chloride (3.80E-06 or 0.5% of ingestion risk).
- Carcinogenic PAHs (1.95E-05 or 3% of ingestion risk).

Groundwater Pathway

Estimates of the carcinogenic risk associated with the consumption of contaminated groundwater for the future use residential scenario are provided in Tables 5-15 and 5-16.

The ingestion route risks for average and upper 95% confidence limit exposures to groundwater from shallow, intermediate, and deep zones are 2.71E-04 and 1.42E-02; 1.1E-04 and 1.28E-04; 5.22E-06 and 3.95E-04. The following chemicals exceed one in one million risk through the consumption of groundwater taken from the shallow, intermediate and deep zones of the aquifer underlying the L.E. Carpenter sites.

Ingestion Risk (Groundwater)

Shallow Zone Chemical	Average Risk (% total)	Upper 95% Confidence Limit Risk (% total)
Bis(2-ethylhexyl)phthalate	3.41E-05 (13)	1.35E-02 (95)
1,1-Dichloroethane	8.47-06 (3)	1.47E-04 (1)
1,1-Dichloroethene	3.00E-05 (11)	3.55E-05 (2.5E-03)
Methylene chloride	3.31E-06 (1)	1.13E-04 (0.01)
Tetrachloroethene	2.46E-06 (0.01)	2.82E-06 (2.0E-03)
Arsenic	1.92E-04 (71)	4.84E-04 (3)

Intermediate Zone Chemical	Average Risk (% total)	Upper 95% Confidence Limits Risk (% total)
Bis(2-ethylhexyl)phthalate	1.20E-06 (1)	7.01E-06 (5)
Arsenic	1.09E-04 (99)	1.21E-04 (95)

Deep Zone Chemical	Average Risk (% total)	Upper 95% Confidence Limit Risk (% total)
Bis(2-ethylhexyl)phthalate	3.13E-06 (60)	3.91E-04 (99)
1,2-Dichloroethane	2.09E-06 (40)	2.40E-06 (6E-03)

It should be noted that the carcinogens 1,1-dichloroethane, 1,1-dichloroethene, trichloroethene, and tetrachloroethene were only found in the shallow groundwater zone in an off-site well. Except for tetrachloroethene none were found in any media on-site. Therefore it is likely that 1,1-dichloroethane, 1,1-dichloroethene, and trichloroethene are not site related. The total cancer risk for shallow depth groundwater excluding the possible non-site related carcinogens is 2 in ten-thousand (2.3E-04) and 1 in one-hundred (1.4E-02) for exposure to average and upper 95% confidence limit contaminant levels, respectively.

Non-ingestion uses of groundwater (e.g., bathing, cooking) pose a greater than one in one million risk when evaluating both average and upper 95% confidence limit contaminant levels from shallow zones of the underlying aquifer (4.77E-05 and 2.71E-04).

Risk due to the inhalation of vapors emitted from noningestion use of the shallow zone of the underlying aquifer is as follows:

Inhalation Risk (Shallow Zone)

Chemical	Average Risk (% total)	Upper 95% Confidence Limit Risk (% total)
1,1-Dichloroethane	8.47E-06 (11)	1.47E-04 (34)
1,1-Dichloroethene	5.99E-05 (79)	7.11E-05 (17)
Methylene chloride	6.18E-06 (8)	2.11E-04 (49)
Trichloroethene	-	1.04E-06 (2E-03)

Risk for the non-ingestion use of groundwater from the shallow zone of the underlying aquifer, excluding the possible non-site related chemicals is 6 in one-million (6E-06) and 2 in ten-thousand (2E-04) for exposure to average and upper 95% confidence limit contaminant levels.

Carcinogenic risk for the non-ingestion use of groundwater form the intermediate zone was calculated to be zero, as the only volatile contaminants found in this medium were

ethylbenzene and xylene which are noncarcinogens. Risk for the noningestion use of groundwater from the deep zone is 2 in one million (2E-06) for both the average and upperbound contaminant levels. For the deep zone, only 1,2-Dichloroethane was responsible for potential carcinogenic risk due to non-ingestion water use.

All Pathways

Tables 5-15 and 5-16 provide a summary of the carcinogenic risk to the future resident through all relevant pathways.

Total lifetime carcinogenic risk to the resident under the future use scenario was calculated assuming the use of groundwater at only one water depth. Therefore, the shallow, intermediate and deep zones were each evaluated for potential lifetime carcinogenic risk. The wader/swimmer exposed to sediment and surface water in the Rockaway River was included in the total risk in the future use scenario because a child resident may also be the wader/swimmer.

The total lifetime carcinogenic risk through all pathways relevant to the future resident scenario, including consumption of groundwater for each of the aquifer zones beneath the site, is as follows:

Future Resident Total Carcinogenic Risk (All Pathways) as a Function of Groundwater Depth

Groundwater Depth	Total Lifetime Carcinogenic Risk	
	Average	Upper 95% Confidence Limit
Shallow	3.5E-04	1.5E-02
Intermediate	1.1E-04	1.3E-04
Deep	7.3E-06	4.0E-04

If the possible non-site related shallow zone groundwater carcinogens are not considered in the exposure estimate, the total lifetime carcinogenic risk to a future resident on the site is 2.5E-04, and 1.4E-02 for exposure to average and upper 95% confidence limit contaminant levels.

5.3.2.2 Non-Carcinogenic Risk

Soil Pathway

The overall hazard index for adult soil exposure is 0.5 and 18 for average and upper 95% confidence limit exposures, respectively. The hazard index for children was calculated as 3.5 and 115.

Dermal contact with soils yields hazard indices for adults of 0.4 and 15 for exposure to average and upper 95% confidence limit soil concentrations, respectively. The following chemicals have hazard quotients that exceed unity (i.e., HQ > 1) for adult dermal contact with soil:

Dermal Hazard Quotients for Adults (Soil)

Chemical	Hazard Quotient	
	Average (% total)	Upper 95% Confidence Limit (% total)
Aroclor 1254	--	3.02E+00 (20)
Benzene	--	1.23E+00 (8)
Bis(2-ethylhexyl)phthalate	--	9.69E+00 (65)

Dermal contact with soils yielded hazard indices for children of 2.55E+00 and 8.72E+01 for average and upper 95% confidence limit exposures, respectively. The following chemicals have hazard quotients that exceed unity for child dermal contact:

Dermal Hazard Quotients for Children (Soil)

Chemical	Hazard Quotient	
	Average (% total)	Upper 95% Confidence Limit (% total)
Aroclor 1254	2.26E+00 (89)	1.77E+01 (20)
Benzene	-	7.20E+00 (8)
Bis(2-ethylhexyl)phthalate	-	5.67E+01 (65)
Ethylbenzene	-	3.57E+00 (4)
Methylene Chloride	-	1.08E+00 (1.2)

Adult ingestion of soils resulted in hazard indices of 1.00E-01 and 2.91E+00 for average and upper 95% confidence limit exposures.

The chemicals exceeding unity for adult ingestion of soils are as follows:

Ingestion Hazard Quotients for Adults (Soils)

Chemical	Hazard Quotient	
	Average (% total)	Upper 95% Confidence Limit (% total)
Bis(2-ethylhexyl)phthalate	-	2.14E+00 (74)

The child ingestion of soils resulted in hazard indices of 9.33E-01 and 2.71E+01 for average and upper 95% confidence limit exposures. The following chemicals exceed unity for child ingestion of soils:

Ingestion Hazard Quotients for Child (Soil)

Chemical	Hazard Quotient	
	Average (% total)	Upper 95% Confidence Limit (% total)
Aroclor 1254	-	6.24E+00 (23)
Bis(2-ethylhexyl)phthalate	-	2.00E+01 (74)

For the inhalation route of exposure, hazard quotients did not exceed unity for either adult or child exposure to average or upper 95% confidence limit contaminant concentrations in soil.

Groundwater Pathway

Hazard indices calculated for the ingestion of groundwater based on varying zones of use are as follows:

Ingestion Hazard Indices for Adult and Child (Groundwater)

Water Depth	Adult Average (Upper Limit)	Child Average (Upper Limit)
Shallow	7.26E+00 (1.35E+02)	1.69E+01 (3.15E+02)
Intermediate	2.34E-01 (1.78E+00)	5.45E-01 (4.15E+00)
Deep	3.80E-02 (2.65E+00)	8.88E-02 (6.18E+00)

The following chemicals have hazard quotients that exceed unity for adult groundwater ingestion:

Ingestion Hazard Quotients for Adults (Groundwater)

Shallow Zone	Adult Hazard Quotient	
Chemical	Average (% total)	Upper 95% Confidence Limit (% total)
Bis(2-ethylhexyl)phthalate	-	8.86E+01 (66)
Ethylbenzene	-	7.43E+00 (6)
Xylene (total)	-	1.71E+00 (1.3)
Antimony	-	3.45E+01 (26)
Intermediate Zone		
Chemical		
Nickel	-	1.46E+00 (82)
Deep Zone		
Chemical		
Bis(2-ethylhexyl)phthalate	-	2.57E+00 (97)

The following chemicals have hazard quotients that exceed unity for child groundwater ingestion:

Ingestion Hazard Quotients for Children (Groundwater)

Shallow Zone	Child Hazard Quotient	
Chemical	Average (% total)	Upper Limit (% total)
Bis (2-ethylhexyl) phthalate	-	2.07E+02 (66)
Ethylbenzene	-	1.73E+01 (5)
Methylene chloride	-	1.08E+00 (0.3)
Xylenes	-	4.00E+00 (1.3)
Antimony	1.54E+01 (91)	8.05E+01 (26)
Arsenic	-	1.19E+00 (0.4)
Intermediate Zone		
Chemical		
Nickel	-	3.40E+00 (82)
Deep Zone		
Chemical		
Bis (2-ethylhexyl) phthalate	-	6.01E+00 (97)

The hazard indices for noningestion uses of groundwater are as follows:

Noningestion Hazard Indices for Adults and Children (Groundwater)

Water Depth	Adult Average (Upper Limit)	Child Average (Upper Limit)
Shallow	7.64E-02 (4.18E+01)	1.78E-01 (9.75E+01)
Intermediate	1.94E-03 (1.21E-01)	4.52E-03 (2.82E-01)
Deep	1.04E-03 (1.19E-03)	2.42E-03 (2.78E-03)

The following are the chemicals whose hazard quotients exceed unity for noningestion uses of groundwater:

Noningestion Hazard Quotients for Adults and Children (Groundwater)

Chemical	Hazard Quotient	
	Average (% total)	Upper 95% Confidence Limit(% total)
Adult		
Ethylbenzene	-	3.91E+00 (4)
Xylene (total)	-	4.00E+01 (96)
Child		
Ethylbenzene	-	1.68E+00 (4)
Xylene (total)	-	9.33E+01 (96)

All Pathways

The cumulative hazard index, when considering all relevant pathways (air, soil, groundwater, sediments and surface water for adults and children) was calculated assuming use of only one groundwater zone; therefore, three different hazard indices were calculated per receptor (i.e., with each of the groundwater zones). Note that child exposure to sediments and surface water of the Rockaway River was included in the future use scenario because a child resident may also be the wader/swimmer.

The following presents the cumulative hazard index for all relevant pathways for each of the groundwater zones:

Cumulative Hazard Indices (All Pathways) as a Function of Groundwater Depth

Groundwater depth	Cumulative Hazard Index	
	Adult Average (Upper Limit)	Child Average (Upper Limit)
Shallow	7.34E+00 (1.77E+02)	1.71E+01 (3.16E+02)
Intermediate	2.36E-01 (1.90E+00)	5.50E-01 (4.43E+00)
Deep	3.90E-02 (2.65E+00)	9.12E-02 (6.18E+00)

5.4 UNCERTAINTY ANALYSIS

5.4.1 Introduction

Uncertainty plays a part in each of the principal components of the risk assessment, including the contamination characterization, the exposure assessment, toxicity assessment, and risk characterization.

Virtually every step in the process involves numerous assumptions, all of which contribute to uncertainty in the ultimate evaluation of risk. These assumptions are developed when, in the absence of empirical or reliable scientific data, "best-judgement" estimates of exposure or dose-response relationships must be made. In addition, EPA recommends the use of guidelines and standard factors in risk assessments conducted under CERCLA. The use of standard factors, provided principally by EPA, is intended to promote consistency in risk assessments. As discussed by EPA (1985), "Consistency with respect to common physical, chemical, and biological factors, and with respect to assumptions about typical exposure situations...enhances the comparability of results and encourages gains in state-of-the-art (risk assessments)." Although the use of standard factors promotes comparability, the ability to accurately estimate risk is directly proportional to a factor's relevance to a site-specific condition.

In this assessment, an effort was made to use assumptions that are conservative, yet plausible. However, the evaluation of potential exposures under conditions not considered realistic (e.g., the installation and use of groundwater wells at the site by a hypothetical resident when the surrounding area is served by public water) were included only as a means of evaluating groundwater quality and not to evaluate risk potential to users. It is likely that the net effect of all the assumptions is to provide the most conservative estimate of overall risk.

The principal goal of any uncertainty analysis is to provide the appropriate decision makers (i.e., this risk managers) and the public with a discussion of the key assumptions and site-

related variables that may have significantly influenced the estimate of potential risk. Although the variation of any factor used in the calculation of exposure will affect the potential total carcinogenic and noncarcinogenic risk, discussions of uncertainty are most appropriately limited to those assumptions most likely to have a significant impact on the predicted estimates of risk. The following narrative addresses those assumptions that appear to be most significant in the effect on potential risk.

5.4.2 Site Specific Uncertainty Factors

The risk assessment process is based on sample data collected for a site. Evaluation of that data is performed with the premise that all substances present above area background are site-related, regardless of whether the substances can be related directly to past use of the site. The process is intended to be unbiased, and this risk assessment was performed in the intended fashion. There are limitations in regard to how representative an "unbiased" risk assessment may be of health and environmental impact potential posed by substances at a site. There are factors that can cause the risk assessment to deviate substantially from being representative of the true condition of the site, and those factors are discussed below:

5.4.2.1 Use of Surrogate Detection Limits

In the analysis of groundwater sampling data, a complete set of detection limits was not available. As stated in Section 2.2.2, detection limits for metals were available for only the first round of sampling. For Round 2, one-half of the contract required detection limits (CRDLs) were substituted in place of actual detection limits where necessary. As in any case where surrogate detection limits are used in place of actual values, this substitution involves a considerable amount of uncertainty.

One-half of the CRDLs were used to avoid an underestimation of metal concentrations in this medium. This substitution should provide a conservative estimation of the actual

contaminant levels and, therefore, a conservative estimate of the potential risk due to exposure to groundwater.

5.4.2.2 Air Sampling

The only volatile contaminant found during the air sampling was tentatively identified as acetone, but due to the lack of a positive identification, these data were considered to be of suspect quality and were not included in the baseline risk assessment. There is some uncertainty involved with the elimination of the consideration of potential health effects due to exposure to acetone in air. Acetone was also detected in soil samples and since the potential risk due to dust inhalation was evaluated, it was felt that the potential for health effects due to inhalation of acetone in air was adequately addressed.

Likewise, several inorganic substances were detected in air samples collected from the site. Risk estimates could not be calculated because no detection limits for metals were available and appropriate CRDLs could not be found. As with the acetone, several of these metals were evaluated through inhalation of fairborne soil. Metals detected in air samples were arsenic, beryllium, cadmium, chromium, copper, lead, nickel, and zinc. In soils, chromium, copper, nickel, and zinc were evaluated. There is some potential for risk due to the inhalation of arsenic, beryllium, cadmium, and lead in air that was not addressed in the risk assessment. However, none of these metals were found in more than 20% of the air samples, which renders the presence of substances in air of questionable relevance to these present at concentrations above background in soils.

5.4.2.3 Uncertainty About Non-Targeted Compounds

Several non-targeted compounds (tentatively identified compounds or TICs) are reported in the sampling data. There is considerable uncertainty involved with assessing the risk potential of these substances because many of the TICs reported lack the specificity needed to identify their toxicity potential. Due to this lack of specificity, the risk potential of these

compounds was not evaluated. At the low levels present at this site, and considering the doubtful identity of the substances, it is unlikely that any of the tentatively identified compounds will contribute to the overall carcinogenic or noncarcinogenic risk from all media.

5.4.2.4 Possible Non-Site Related Contaminants

There is doubt whether several substances demonstrating risk potential above minimum levels are actually present based on their frequency of detection. In soils, benzene was detected in only 6 of 97 samples. In sediments and surface water, all substances exceeding minimum risk levels were detected frequently. In shallow groundwater, 1,1-dichloroethane, 1,1-dichloroethene, tetrachloroethene, and trichloroethene were detected in only 2 of 30 samples collected (both of which were from offsite locations) while antimony and methylene chloride were detected in only 5 of 30 samples collected. Methylene chloride was detected in many groundwater samples. However, each detection was either a J-value (i.e., below the quantifiable reporting limit), associated with laboratory or field blank contamination, or both. Therefore, the presence and quantification of methylene chloride at the site is highly suspect. Nevertheless, the estimated concentrations of methylene chloride were included in the potential. In the intermediate groundwater arsenic and bis (2-ethylhexyl) phthalate were detected only 2 of 14 and 1 of 14 times while nickel was detected only 4 of 14 times. In the deep groundwater, both bis (2-ethylhexyl) phthalate and 1,2-dichloroethane were detected only once in 10 samples taken. As is evident, the majority of substances contributing to risk above minimum levels of concern were present at relatively low frequencies of detection.

The origin of the substances detected in offsite wells is also suspect. Two rounds of groundwater samples were collected from MW-13s, which is located on Air Products property. This area is separated from the site by a drainage ditch that intercepts shallow groundwater flow. Groundwater samples from MW-13s contained 1,-dichloroethane, 1,1-dichloroethene, tetrachloroethene, and trichloroethene. In calculating potential risks posed

by the L.E. Carpenter site, it would be inappropriate to include these compounds for the following reasons:

- The drainage ditch intercepts shallow groundwater, thus serving as a hydraulic barrier between the two areas; therefore, substances in the shallow groundwater probably originates on the Air Products side of the drainage ditch.

- None of these compounds were found in any groundwater samples collected on or directly downgradient of the Carpenter facility.

- There is no history of use of these compounds at L.E. Carpenter.

- Substances associated with L.E. Carpenter that appear in the groundwater on or downgradient of the site (e.g., DEHP, xylene) are not present in groundwater from MW-13s.

Potential risks have been calculated with and without the compounds found in MW-13s. However, remedial measures at the site should focus on the potential risks estimated for site-related contamination since these potential risks can be addressed by L.E. Carpenter.

Lead was detected at relatively low levels on the site in both stream sediments from the Rockaway River and groundwater from the deep aquifer. In surface water and soil samples, lead was detected only at levels below background concentrations. Since lead is not known to have been utilized in any process at the facility, it is unlikely that the lead detected in sediment and groundwater samples is site related.

Numerous polycyclic aromatic hydrocarbon (PAHs) including benzo(a)pyrene and benzo(a)anthracene, were detected in soil samples taken from the site as well as stream sediments in the Rockaway River. Significant levels of PAHs were detected in stream

sediments at locations upgradient from production areas near the railroad right of way as well as points further downstream. The sediment sampling sites in question were considered to be background locations, as they are hydrologically upgradient from the site. It is not possible to precisely quantify the influence of the railroad right of way (and nearby parking areas) on these PAH levels; however, the possibility does exist that past activity in these areas could have contributed to PAH levels in sediments at this location. There is some uncertainty about the source of the PAHs found in sediments at these background locations as well as locations further downstream.

5.4.2.5 Uncertainty with Potential Exposures

A major uncertainty exists with estimating potential exposures under various hypothetical site uses. Probably the most dubious hypothetical use is residential use with water supplied by onsite groundwater. The site has been used for mining, industrial and commercial purposes for over 100 years and residential use of the site would require rezoning. The area is served by public water supply system, making the installation of an onsite groundwater supply well not only ill-advised, but unnecessary; therefore, the exposures associated with residential use of the site, especially groundwater use, are not plausible.

Potential exposures related to the other use scenarios are also uncertain; therefore, conservative assumptions were incorporated into the risk assessment.

5.4.3 Toxicity Assessment Uncertainty

Appropriate toxicity values were available, or could be derived for all of the chemicals of concern with the exceptions of slope factors for butyl benzyl phthalate and reference doses and slope factors for lead. In the absence of these factors, the potential carcinogenic effects of butylbenzyl phthalate and lead, and the potential noncarcinogenic effects of lead were not quantitatively evaluated. Butyl benzyl phthalate was identified as a contaminant of

concern in shallow groundwater, soil and stream sediments. Lead was identified as a contaminant of concern in deep groundwater and stream sediments.

It is likely that at the concentrations present, butylbenzyl phthalate would contribute only marginally to the overall carcinogenic risk due to exposure to sediments, groundwater, or soil, especially when the weak carcinogenic evidence (i.e., its Group C classification) is considered.

A carcinogenic slope factor was not available and could not be derived for lead. Reference doses (previously available or derived) were not used based on Region II EPA guidance (EPA, 1989b). Carcinogenic and non-carcinogenic risks due to lead were not quantitatively evaluated. These risks were addressed qualitatively (Section 4.4) using current EPA guidance based on exposure levels considered protective of health in exposed children (the sensitive population.

A more general uncertainty relates to whether toxicity potentials of the substances calculated to pose risk potentials above minimum levels of concern are representative of humans. Of the substances of interest in this risk assessment, only arsenic, benzene, and chromium have toxicity endpoints that were based on human exposure. Nickel is known to cause cancer in humans if inhaled but is not of concern by that route when the L.E. Carpenter site is considered.

The chromium risk above minimum levels of concern originated entirely on the assumption that 1/8 of the total chromium detected was present in the hexavalent form which is the form known to cause cancer in humans inhaling the material. It is not known whether any hexavalent chromium is present at the site (none is known to have been used by L.E. Carpenter).

The remaining substances are considered to be toxic to humans, as based on the most conservative outcome of studies with laboratory animals. Until evidence with humans is

collected, there is no assurance that toxicity values used in this risk assessment approximate actual toxicity potential to any persons using the site at present or the future.

5.5 SENSITIVITY ANALYSIS

The only variable quantitatively evaluated in the sensitivity analysis for this risk assessment is the influence of the Clement "Comparative Potency" approach for PAHs on carcinogenic risk. For the polycyclic aromatic hydrocarbons (PAHs), two approaches were utilized to evaluate carcinogenic risk. Tables 5-21 to 5-28 compare the results of the standard EPA approach (EPA, 1989a) to the results of the ICF-Clement comparative potency (CP) approach (Clement, 1988). The CP approach (contracted by EPA) utilizes a mathematical model that appears to be specifically applicable to what is theoretically known about the mechanisms associated with the carcinogenicity of PAHs. The model is then used on data derived from animal experiments. The results of this modeling were then used to produce a relative potency factor for each individual PAH. In general, these factors were anywhere from a tenth to a thousandth of the potency of benzo[a]pyrene. In fact, for some PAHs the data do not suggest any evidence for carcinogenicity. ICF-Clement evaluated the results of studies on PAH mixtures to compare the number of tumors predicted from the added potency factors to the actual experimental results. This exercise demonstrated that there were many more predicted tumors than actual tumors, suggesting that this type of analysis is still very conservative. As can be seen from the tables, the overall cancer risk for exposure to all organics and inorganics is lower using the CP approach numbers for the PAHs but, in general, the overall risk is changed by less than an order of magnitude. EPA is still evaluating whether to accept the CP approach for PAHs.

5.6 SUMMARY

A baseline risk assessment was conducted to determine the extent to which site-related contamination in various media on and in the vicinity of the L.E. Carpenter site may pose a human health and environmental risk to potential receptors under present and future land

use conditions. The baseline assessment was conducted to determine the risk due to chronic exposure to carcinogens and noncarcinogens for several receptors under two separate scenarios.

- Present use scenario.
  - A worker at the L.E. Carpenter site.
  - A trespasser on the L.E. Carpenter site.
  - A wader/swimmer in the Rockaway River, adjacent to the L.E. Carpenter site, and
  - A recreational fisherman of the Rockaway River adjacent to the L.E. Carpenter site.
- Future use scenario.
  - A hypothetical adult resident of property formerly occupied by the L.E. Carpenter site.
  - A hypothetical child resident of property formerly occupied by the L.E. Carpenter site.
  - A wader/swimmer in the Rockaway River adjacent to the former L.E. Carpenter site, and
  - A recreational fisherman of the Rockaway River adjacent to the site.

A summary for all substances that, at reasonable maximum concentrations exceeded minimum risk levels (i.e., one excess cancer case per million persons or a hazard index of one) either alone or in combination with other substances is presented in Table 5-29. If the listing in Table 5-29 were modified to include only those substances exhibiting at least one excess case of cancer per one-hundred thousand persons or a hazard index of 10 using the upper 95% confidence limit concentrations, the substances remaining would be as follows:

TABLE 5-1. AVERAGE CARCINOGENIC RISK - WORKER

CHEMICALS	SOIL PATHWAY			WORKER TOTAL RISK	
	INGESTION	INHALATION	DERMAL	ALL PATHWAYS	PERCENT TOTAL RISK
ORGANICS					
Aroclor 1254	5.65E-07	6.79E-09	5.12E-06	5.69E-06	39.77
Benzene	1.74E-10	2.09E-12	8.76E-09	8.93E-09	0.06
Bis(2-ethylhexyl) phthalate	3.37E-07	4.05E-09	3.05E-06	3.39E-06	23.71
Methylene chloride	2.06E-10	4.61E-12	1.03E-08	1.06E-08	0.07
Polycyclic aromatic hydrocarbons (PAHs)					
Benzo (a) anthracene	1.96E-07	1.25E-09	7.09E-07	9.06E-07	6.34
Benzo(a)pyrene	1.74E-07	1.11E-09	6.29E-07	8.03E-07	5.62
Benzo(b)fluoranthene/Benzo(k)fluoranthene	2.59E-07	1.65E-09	9.39E-07	1.20E-06	8.39
Benzo(g,h,i)perylene	9.93E-10	1.68E-12	3.59E-09	4.59E-09	0.03
Chrysene	1.93E-07	1.23E-09	6.99E-07	8.93E-07	6.24
Dibenzo(a,h)anthracene	8.80E-08	5.60E-10	3.18E-07	4.07E-07	2.85
Indeno(1,2,3,c,d) pyrene	1.56E-07	9.93E-10	5.65E-07	7.22E-07	5.05
Pyrene	4.79E-09	8.11E-12	1.73E-08	2.21E-08	0.15
Tetrachloroethene	2.98E-11	2.31E-14	1.50E-09	1.53E-09	0.01
INORGANICS					
Chromium VI		2.22E-07		2.22E-07	1.55
Nickel		2.31E-08		2.31E-08	0.16
ROUTE TOTAL RISK	1.97E-06	2.62E-07	1.21E-05	1.43E-05	100.00
PERCENT TOTAL RISK	13.81	1.83	84.36	100.00	

TABLE 5-2. UPPER 95 CARCINOGENIC RISK - WORKER

CHEMICALS	SOIL PATHWAY			WORKER TOTAL RISK	
	INGESTION	INHALATION	DERMAL	ALL PATHWAYS	PERCENT TOTAL RISK
ORGANICS					
Aroclor 1254	4.42E-06	5.30E-08	4.00E-05	4.45E-05	5.39
Benzene	1.74E-07	2.09E-09	8.76E-06	8.94E-06	1.08
Bis(2-ethylhexyl) phthalate	7.36E-05	8.83E-07	6.66E-04	7.40E-04	89.76
Methylene chloride	4.07E-07	9.12E-09	2.05E-05	2.09E-05	2.53
Polycyclic aromatic hydrocarbons (PAHs)					
Benzo (a) anthracene	4.37E-07	2.78E-09	1.58E-06	2.02E-06	0.25
Benzo(a)pyrene	3.08E-07	1.96E-09	1.12E-06	1.43E-06	0.17
Benzo(b)fluoranthene/Benzo(k)fluoranthene	5.66E-07	3.60E-09	2.05E-06	2.62E-06	0.32
Benzo(g,h,i)perylene	1.76E-09	2.98E-12	6.38E-09	8.14E-09	0.00
Chrysene	4.23E-07	2.69E-09	1.53E-06	1.96E-06	0.24
Dibenzo(a,h)anthracene	1.02E-07	6.46E-10	3.68E-07	4.70E-07	0.06
Indeno(1,2,3,c,d) pyrene	2.44E-07	1.55E-09	8.82E-07	1.13E-06	0.14
Pyrene	1.09E-08	1.84E-11	3.94E-08	5.03E-08	0.01
Tetrachloroethene	3.32E-11	2.58E-14	1.67E-09	1.70E-09	0.00
INORGANICS					
Chromium VI		4.08E-07		4.08E-07	0.05
Nickel		3.78E-08		3.78E-08	0.00
ROUTE TOTAL RISK	8.07E-05	1.41E-06	7.43E-04	8.25E-04	100.00
PERCENT TOTAL RISK	9.78	0.17	90.05	100.00	

TABLE 5-9. AVERAGE CARCINOGENIC RISK - TRESPASSER

CHEMICAL	SOIL PATHWAY			TRESPASSER TOTAL RISK	
	INGESTION	INHALATION	DERMAL	ALL PATHWAYS	PERCENT TOTAL RISK
ORGANICS					
Aroclor 1254	1.77E-08	1.77E-11	1.60E-07	1.78E-07	40.36
Benzene	5.45E-12	5.45E-15	2.74E-10	2.79E-10	0.06
Bis(2-ethylhexyl) phthalate	1.05E-08	1.05E-11	9.53E-08	1.06E-07	24.07
Methylene chloride	6.43E-12	1.20E-14	3.23E-10	3.30E-10	0.07
Polycyclic aromatic hydrocarbons (PAHs)					
Benzo (a) anthracene	6.12E-09	3.25E-12	2.22E-08	2.83E-08	6.43
Benzo(a)pyrene	5.43E-09	2.88E-12	1.96E-08	2.51E-08	5.70
Benzo(b)fluoranthene/Benzo(k)fluoranthene	8.11E-09	4.30E-12	2.93E-08	3.74E-08	8.51
Benzo(g,h,i)perylene	3.10E-11	4.37E-15	1.12E-10	1.43E-10	0.03
Chrysene	6.03E-09	3.20E-12	2.18E-08	2.79E-08	6.34
Dibenzo(a,h)anthracene	2.75E-09	1.46E-12	9.95E-09	1.27E-08	2.89
Indeno(1,2,3,c,d) pyrene	4.88E-09	2.59E-12	1.76E-08	2.25E-08	5.12
Pyrene	1.50E-10	2.11E-14	5.42E-10	6.91E-10	0.16
Tetrachloroethene	9.30E-13	6.02E-17	4.67E-11	4.77E-11	0.01
INORGANICS					
Chromium VI	0.00E+00	5.77E-10	0.00E+00	5.77E-10	0.13
Nickel	0.00E+00	6.00E-11	0.00E+00	6.00E-11	0.01
ROUTE TOTAL RISK	6.17E-08	6.83E-10	3.77E-07	4.40E-07	100.00
PERCENT TOTAL RISK	14.03	0.16	85.71	100.00	

TABLE 5-4. UPPER 95 CARCINOGENIC RISK - TRESPASSER

CHEMICAL	SOIL PATHWAY			TRESPASSER TOTAL RISK	
	INGESTION	INHALATION	DERMAL	ALL PATHWAYS	PERCENT TOTAL RISK
ORGANICS					
Aroclor 1254	1.38E-07	1.38E-10	1.25E-06	1.39E-06	5.40
Benzene	5.45E-09	5.45E-12	2.74E-07	2.79E-07	1.09
Bis(2-ethylhexyl) phthalate	2.30E-06	2.30E-09	2.08E-05	2.31E-05	89.93
Methylene chloride	1.27E-06	2.36E-11	6.40E-07	6.53E-07	2.54
Polycyclic aromatic hydrocarbons (PAHs)					
Benzo (a) anthracene	1.37E-06	7.25E-12	4.95E-06	6.31E-06	0.25
Benzo(a)pyrene	9.64E-09	5.11E-12	3.49E-06	4.45E-06	0.17
Benzo(b)fluoranthene/Benzo(k)fluoranthene	1.77E-06	9.39E-12	6.40E-06	8.18E-06	0.32
Benzo(g,h,i)perylene	5.51E-11	7.75E-15	1.99E-10	2.54E-10	0.00
Chrysene	1.32E-06	7.02E-12	4.79E-06	6.11E-06	0.24
Dibenzo(a,h)anthracene	3.17E-09	1.68E-12	1.15E-06	1.47E-06	0.06
Indeno(1,2,3,c,d) pyrene	7.62E-09	4.04E-12	2.76E-06	3.52E-06	0.14
Pyrene	3.40E-10	4.80E-14	1.23E-09	1.57E-09	0.01
Tetrachloroethene	1.04E-12	6.72E-17	5.22E-11	6.33E-11	0.00
INORGANICS					
Chromium VI	0.00E+00	1.06E-09	0.00E+00	1.06E-09	0.00
Nickel	0.00E+00	9.84E-11	0.00E+00	9.84E-11	0.00
ROUTE TOTAL RISK	2.52E-06	3.66E-09	2.32E-05	2.57E-05	100.00
PERCENT TOTAL RISK	9.81	0.01	90.32	100.00	

TABLE 5-5. AVERAGE CARCINOGENIC RISK - WADER/SWIMMER

CHEMICAL	SEDIMENTS PATHWAY			SURFACE WATER PATHWAY			WADER/SWIMMER TOTAL RISK	
	INGESTION	DERMAL	PATHWAY TOTAL	INGESTION	DERMAL	PATHWAY TOTAL	ALL PATHWAYS	PERCENT TOTAL RISK
ORGANICS								
Bis(2-ethylhexyl) phthalate	5.38E-10	3.53E-09	4.07E-09				4.07E-09	0.27
Methylene chloride	2.71E-12	9.89E-12	1.26E-11				1.26E-11	0.00
Polycyclic aromatic hydrocarbons (PAHs)								
Benzo (a) anthracene	6.40E-08	1.68E-07	2.32E-07				2.32E-07	15.18
Benzo(a)pyrene	5.75E-08	1.51E-07	2.09E-07				2.09E-07	13.69
Benzo(b)fluoranthene/Benzo(k)fluoranthene	8.54E-08	2.24E-07	3.10E-07				3.10E-07	20.25
Benzo(g,h,i)perylene	2.93E-10	7.70E-10	1.06E-09				1.06E-09	0.07
Chrysene	7.01E-08	1.84E-07	2.54E-07				2.54E-07	16.61
Dibenzo(a,h)anthracene	2.38E-08	6.25E-08	8.63E-08				8.63E-08	5.64
Indeno(1,2,3,c,d) pyrene	3.82E-08	1.00E-07	1.39E-07				1.39E-07	9.05
Pyrene	2.07E-09	5.43E-09	7.50E-09				7.50E-09	0.49
Tetrachloroethene	1.11E-12	4.05E-11	4.16E-11				4.16E-11	0.00
INORGANICS								
Arsenic	8.48E-08	0.00E+00	8.48E-08	5.18E-08	1.53E-07	2.05E-07	2.90E-07	18.99
ROUTE TOTAL RISK	4.27E-07	9.00E-07	1.33E-06	5.18E-08	1.53E-07	2.05E-07	1.53E-06	100.00
PERCENT TOTAL RISK	27.88	58.86	86.73	3.39	10.00	13.39	100.00	

TABLE 5-6. UPPER 95 CARCINOGENIC RISK - WADER/SWIMMER

CHEMICAL	SEDIMENTS PATHWAY			SURFACE WATER PATHWAY			WADER/SWIMMER TOTAL RISK	
	INGESTION	DERMAL	PATHWAY TOTAL	INGESTION	DERMAL	PATHWAY TOTAL	ALL PATHWAYS	PERCENT TOTAL RISK
ORGANICS								
Bis(2-ethylhexyl) phthalate	6.51E-09	4.28E-08	4.93E-08				4.93E-08	0.61
Methylene chloride	2.71E-12	9.89E-12	1.26E-11				1.26E-11	0.00
Polycyclic aromatic hydrocarbons (PAHs)								
Benzo (a) anthracene	4.51E-07	1.18E-06	1.63E-06				1.63E-06	20.11
Benzo(a)pyrene	3.52E-07	9.25E-07	1.28E-06				1.28E-06	15.71
Benzo(b)fluoranthene/Benzo(k)fluoranthene	5.77E-07	1.52E-06	2.09E-06				2.09E-06	25.76
Benzo(g,h,i)perylene	1.43E-09	3.76E-09	5.19E-09				5.19E-09	0.06
Chrysene	4.56E-07	1.20E-06	1.66E-06				1.66E-06	20.42
Dibenzo(a,h)anthracene	9.86E-08	2.59E-07	3.58E-07				3.58E-07	4.40
Indeno(1,2,3,c,d) pyrene	1.76E-07	4.63E-07	6.39E-07				6.39E-07	7.85
Pyrene	2.07E-08	5.44E-08	7.51E-08				7.51E-08	0.92
Tetrachloroethene	2.73E-12	9.97E-11	1.02E-10				1.02E-10	0.00
INORGANICS								
Arsenic	1.28E-07	0.00E+00	1.28E-07	5.25E-08	1.55E-07	2.07E-07	3.36E-07	4.13
ROUTE TOTAL RISK	2.27E-06	5.65E-06	7.92E-06	5.25E-08	1.55E-07	2.07E-07	8.13E-06	100.00
PERCENT TOTAL RISK	27.91	69.52	97.42	0.65	1.91	2.55	100.00	

TABLE 5-7. AVERAGE AND UPPER 95 CARCINOGENIC RISK FROM FISH INGESTION - ADULT AND CHILD

CHEMICAL	AVERAGE ADULT	AVERAGE CHILD	TOTAL LIFETIME	UPPER 95 ADULT	UPPER 95 CHILD	TOTAL LIFETIME
INORGANICS						
Arsenic	3.91E-04	2.28E-04	6.19E-04	3.97E-04	2.32E-04	6.29E-04
TOTAL	3.91E-04	2.28E-04	6.19E-04	3.97E-04	2.32E-04	6.29E-04

TABLE 5-8. AVERAGE HAZARD INDEX - WORKER

CHEMICAL	SOIL PATHWAY			WORKER TOTAL RISK	
	INGESTION	INHALATION	DERMAL	ALL PATHWAYS	PERCENT TOTAL RISK
ORGANICS					
Acetone	7.79E-07	5.14E-10	3.92E-05	4.00E-05	0.01
Aroclor 1254	4.28E-02	7.04E-06	3.87E-01	4.30E-01	87.88
Benzene	2.45E-05	2.94E-07	1.23E-03	1.26E-03	0.26
Bis(2-ethylhexyl) phthalate	4.91E-03	2.31E-04	4.44E-02	4.96E-02	10.13
Butyl-benzyl phthalate	6.97E-07	8.37E-09	6.31E-06	7.01E-06	0.00
Di-n-butyl phthalate	1.58E-06	3.71E-07	1.43E-05	1.62E-05	0.00
Di-n-octyl phthlate	1.88E-05	2.26E-07	1.70E-04	1.89E-04	0.04
Ethylbenzene	9.06E-08	2.46E-10	4.56E-06	4.65E-06	0.00
Methylene chloride	1.86E-06	1.57E-09	9.37E-05	9.56E-05	0.02
Methyl ethyl ketone	4.63E-08	3.09E-10	2.33E-06	2.38E-06	0.00
Polycyclic aromatic hydrocarbons (PAHs)					
Benzo (a) anthracene	2.32E-06	2.78E-08	8.38E-06	1.07E-05	0.00
Benzo(a)pyrene	2.05E-06	2.46E-08	7.43E-06	9.51E-06	0.00
Benzo(b)fluoranthene/Benzo(k)fluoranthene	3.06E-06	3.68E-08	1.11E-05	1.42E-05	0.00
Benzo(g,h,i)perylene	1.91E-06	2.29E-08	6.90E-06	8.83E-06	0.00
Chrysene	2.28E-06	2.74E-08	8.26E-06	1.06E-05	0.00
Dibenzo(a,h)anthracene	1.04E-06	1.25E-08	3.76E-06	4.82E-06	0.00
Fluoranthene	1.01E-06	1.21E-08	3.65E-06	4.67E-06	0.00
Indeno(1,2,3,c,d) pyrene	1.84E-06	2.21E-08	6.67E-06	8.54E-06	0.00
Phenanthrene	2.31E-06	2.77E-08	8.36E-06	1.07E-05	0.00
Pyrene	2.50E-06	3.00E-08	9.06E-06	1.16E-05	0.00
Tetrachloroethene	2.38E-07	1.65E-10	1.20E-05	1.22E-05	0.00
Toluene	7.17E-09	4.52E-11	3.61E-07	3.68E-07	0.00
Xylenes (total)	2.27E-08	6.36E-09	1.14E-06	1.17E-06	0.00
INORGANICS					
Chromium III	1.29E-05	3.03E-04	0.00E+00	3.16E-04	0.06
Chromium VI	3.67E-04	4.32E-04	0.00E+00	7.99E-04	0.16
Copper	9.10E-04	3.96E-04	0.00E+00	1.31E-03	0.27
Nickel	4.66E-04	1.10E-03	0.00E+00	1.56E-03	0.32
Zinc	4.65E-04	2.19E-04	0.00E+00	6.84E-04	0.14
Cyanide	3.64E-05	1.71E-06	3.29E-03	3.33E-03	0.68
ROUTE TOTAL RISK	5.00E-02	2.69E-03	4.36E-01	4.89E-01	100.00
PERCENT TOTAL RISK	10.23	0.55	89.23	100.00	

TABLE 5-9. UPPER 95 HAZARD INDEX - WORKER

CHEMICAL	SOIL PATHWAY			WORKER TOTAL RISK	
	INGESTION	INHALATION	DERMAL	ALL PATHWAYS	PERCENT TOTAL RISK
ORGANICS					
Acetone	6.14E-04	4.05E-07	3.09E-02	3.15E-02	0.19
Aroclor 1254	3.34E-01	5.51E-05	3.02E+00	3.36E+00	20.45
Benzene	2.45E-02	2.94E-04	1.23E+00	1.26E+00	7.65
Bis(2-ethylhexyl) phthalate	1.07E+00	5.04E-02	9.69E+00	1.08E+01	65.85
Butyl-benzyl phthalate	1.64E-05	1.97E-07	1.48E-04	1.65E-04	0.00
Di-n-butyl phthalate	4.75E-06	1.12E-06	4.30E-05	4.88E-05	0.00
Di-n-octyl phthlate	1.46E-04	1.75E-06	1.32E-03	1.47E-03	0.01
Ethylbenzene	1.21E-02	3.29E-05	6.10E-01	6.23E-01	3.79
Methylene chloride	3.69E-03	3.10E-06	1.86E-01	1.89E-01	1.15
Methyl ethyl ketone	3.51E-06	2.34E-08	1.77E-04	1.80E-04	0.00
Polycyclic aromatic hydrocarbons (PAHs)					
Benzo (a) anthracene	5.17E-06	6.20E-08	1.87E-05	2.39E-05	0.00
Benzo(a)pyrene	3.64E-06	4.37E-08	1.32E-05	1.69E-05	0.00
Benzo(b)fluoranthene/Benzo(k)fluoranthene	6.69E-06	8.03E-08	2.42E-05	3.10E-05	0.00
Benzo(g,h,i)perylene	3.38E-06	4.06E-08	1.22E-05	1.57E-05	0.00
Chrysene	5.00E-06	6.00E-08	1.81E-05	2.32E-05	0.00
Dibenzo(a,h)anthracene	1.20E-06	1.44E-08	4.34E-06	5.56E-06	0.00
Fluoranthene	4.18E-06	5.01E-08	1.51E-05	1.94E-05	0.00
Indeno(1,2,3,c,d) pyrene	2.88E-06	3.46E-08	1.04E-05	1.33E-05	0.00
Phenanthrene	6.60E-06	7.91E-08	2.39E-05	3.05E-05	0.00
Pyrene	5.69E-06	6.83E-08	2.06E-05	2.64E-05	0.00
Tetrachloroethene	2.66E-07	1.84E-10	1.34E-05	1.36E-05	0.00
Toluene	2.45E-08	1.55E-10	1.23E-06	1.26E-06	0.00
Xylenes (total)	2.64E-03	7.40E-04	1.33E-01	1.36E-01	0.83
INORGANICS					
Chromium III	2.37E-05	5.57E-04	0.00E+00	5.81E-04	0.00
Chromium VI	6.77E-04	7.96E-04	0.00E+00	1.47E-03	0.01
Copper	1.71E-03	7.43E-04	0.00E+00	2.45E-03	0.01
Nickel	7.64E-04	1.80E-03	0.00E+00	2.56E-03	0.02
Zinc	9.43E-04	4.44E-04	0.00E+00	1.39E-03	0.01
Cyanide	5.00E-05	2.35E-06	4.52E-03	4.58E-03	0.03
ROUTE TOTAL RISK	1.45E+00	5.59E-02	1.49E+01	1.64E+01	100.00
PERCENT TOTAL RISK	8.85	0.34	90.81	100.00	

TABLE 5-10. AVERAGE HAZARD INDEX - TRESPASSER

CHEMICAL	SOIL PATHWAY			TRESPASSER TOTAL RISK	
	INGESTION	INHALATION	DERMAL	ALL PATHWAYS	PERCENT TOTAL RISK
ORGANICS					
Acetone	9.76E-07	5.36E-11	4.91E-05	5.00E-05	0.04
Aroclor 1254	5.36E-03	7.35E-07	4.85E-02	5.38E-02	43.74
Benzene	3.07E-06	3.07E-09	1.54E-04	1.57E-04	0.13
Bis(2-ethylhexyl) phthalate	6.15E-03	2.41E-05	5.66E-02	6.16E-02	50.22
Butyl-benzyl phthalate	8.73E-06	8.73E-11	7.90E-07	8.77E-07	0.00
Di-n-butyl phthalate	1.97E-07	3.87E-06	1.76E-06	2.02E-06	0.00
Di-n-octyl phthlate	2.36E-05	2.36E-06	2.13E-04	2.37E-04	0.19
Ethylbenzene	1.13E-06	2.58E-11	5.71E-07	5.82E-07	0.00
Methylene chloride	2.33E-06	1.63E-10	1.17E-04	1.20E-04	0.10
Methyl ethyl ketone	5.80E-09	3.22E-12	2.92E-07	2.97E-07	0.00
Polycyclic aromatic hydrocarbons (PAHs)					
Benzo (a) anthracene	2.90E-07	2.90E-10	1.05E-06	1.34E-06	0.00
Benzo(a)pyrene	2.57E-07	2.57E-10	9.30E-07	1.19E-06	0.00
Benzo(b)fluoranthene/Benzo(k)fluoranthene	3.84E-07	3.84E-10	1.39E-06	1.77E-06	0.00
Benzo(g,h,i)perylene	2.39E-07	2.39E-10	8.64E-07	1.10E-06	0.00
Chrysene	2.86E-07	2.86E-10	1.03E-06	1.32E-06	0.00
Dibenzo(a,h)anthracene	1.30E-07	1.30E-10	4.71E-07	6.02E-07	0.00
Fluoranthene	1.26E-07	1.26E-10	4.57E-07	5.83E-07	0.00
Indeno(1,2,3,c,d) pyrene	2.31E-07	2.31E-10	8.35E-07	1.07E-06	0.00
Phenanthrene	2.89E-07	2.89E-10	1.05E-06	1.34E-06	0.00
Pyrene	3.13E-07	3.13E-10	1.13E-06	1.45E-06	0.00
Tetrachloroethene	2.98E-06	1.72E-11	1.50E-06	1.50E-06	0.00
Toluene	6.74E-09	4.72E-12	9.39E-07	9.45E-07	0.00
Xylenes (total)	1.42E-06	6.63E-10	7.14E-07	7.29E-07	0.00

TABLE 5-10. AVERAGE HAZARD INDEX - TRESPASSER (continued)

CHEMICAL	SOIL PATHWAY			TRESPASSER TOTAL RISK	
	INGESTION	INHALATION	DERMAL	ALL PATHWAYS	PERCENT TOTAL RISK
INORGANICS					
Chromium III	1.81E-06	3.16E-05	0.00E+00	3.32E-05	0.03
Chromium VI	1.15E-04	4.51E-05	0.00E+00	1.60E-04	0.13
Copper	1.14E-03	4.13E-05	0.00E+00	1.18E-03	0.96
Nickel	8.84E-04	1.14E-04	0.00E+00	9.98E-04	0.87
Zinc	5.83E-04	9.29E-05	0.00E+00	6.06E-04	0.49
Cyanide	4.58E-05	1.79E-07	4.12E-03	4.17E-03	3.39
ROUTE TOTAL RISK	1.40E-02	2.60E-04	1.09E-01	1.23E-01	100.00
PERCENT TOTAL RISK	11.38	0.23	88.39	100.00	

TABLE 5-11. UPPER 95 HAZARD INDEX - TRESPASSER

CHEMICAL	SOIL PATHWAY			TRESPASSER TOTAL RISK	
	INGESTION	INHALATION	DERMAL	ALL PATHWAYS	PERCENT TOTAL RISK
ORGANICS					
Acetone	7.89E-04	4.23E-08	3.87E-02	3.94E-02	0.27
Aroclor 1254	4.19E-02	5.76E-06	3.70E-01	4.21E-01	2.90
Benzene	3.07E-03	3.07E-06	1.54E-01	1.57E-01	1.08
Bis(2-ethylhexyl) phthalate	1.34E+00	5.26E-03	1.21E+01	1.35E+01	92.91
Butyl-benzyl phthalate	2.05E-06	2.05E-09	1.86E-05	2.06E-06	0.00
Di-n-butyl phthalate	5.95E-07	1.17E-07	5.38E-06	6.09E-06	0.00
Di-n-octyl phthlate	1.82E-04	1.82E-07	1.65E-03	1.83E-03	0.01
Ethylbenzene	1.52E-03	3.43E-06	7.64E-02	7.80E-02	0.54
Methylene chloride	4.62E-03	3.24E-07	2.32E-01	2.37E-01	1.63
Methyl ethyl ketone	4.40E-07	2.44E-10	2.21E-05	2.26E-05	0.00
Polycyclic aromatic hydrocarbons (PAHs)					
Benzo (a) anthracene	6.47E-07	6.47E-10	2.94E-06	2.99E-06	0.00
Benzo(a)pyrene	4.56E-07	4.56E-10	1.65E-06	2.11E-06	0.00
Benzo(b)fluoranthene/Benzo(k)fluoranthene	8.36E-07	8.36E-10	3.03E-06	3.87E-06	0.00
Benzo(g,h,i)perylene	4.23E-07	4.23E-10	1.53E-06	1.96E-06	0.00
Chrysene	6.26E-07	6.26E-10	2.27E-06	2.89E-06	0.00
Dibenzo(a,h)anthracene	1.50E-07	1.50E-10	5.44E-07	6.94E-07	0.00
Fluoranthene	5.23E-07	5.23E-10	1.89E-06	2.42E-06	0.00
Indeno(1,2,3,c,d) pyrene	3.61E-07	3.61E-10	1.31E-06	1.67E-06	0.00
Phenanthrene	8.26E-07	8.26E-10	2.99E-06	3.82E-06	0.00
Pyrene	7.13E-07	7.13E-10	2.58E-06	3.29E-06	0.00
Tetrachloroethene	3.33E-06	1.92E-11	1.67E-06	1.71E-06	0.00
Toluene	2.30E-06	1.61E-11	1.16E-06	1.18E-06	0.00
Xylenes (total)	1.65E-03	7.72E-05	8.32E-02	8.49E-02	0.58

TABLE 5-11. UPPER 95 HAZARD INDEX - TRESPASSER (continued)

CHEMICAL	SOIL PATHWAY			TRESPASSER TOTAL RISK	
	INGESTION	INHALATION	DERMAL	ALL PATHWAYS	PERCENT TOTAL RISK
INORGANICS					
Chromium III	2.97E-06	5.82E-05	0.00E+00	6.11E-05	0.00
Chromium VI	2.12E-04	8.31E-05	0.00E+00	2.95E-04	0.00
Copper	2.14E-03	7.76E-05	0.00E+00	2.22E-03	0.02
Nickel	9.67E-04	1.88E-04	0.00E+00	1.14E-03	0.01
Zinc	1.18E-03	4.63E-05	0.00E+00	1.22E-03	0.01
Cyanide	6.26E-05	2.46E-07	5.67E-03	5.73E-03	0.04
ROUTE TOTAL RISK	1.40E+00	5.60E-03	1.31E+01	1.45E+01	100.00
PERCENT TOTAL RISK	9.64	0.04	90.32	100.00	

TABLE 5-12. AVERAGE HAZARD INDEX - WADER/SWIMMER

CHEMICAL	SEDIMENTS PATHWAY			SURFACE WATER PATHWAY			WADER/SWIMMER TOTAL INDICES	
	INGESTION	DERMAL	PATHWAY TOTAL	INGESTION	DERMAL	PATHWAY TOTAL	ALL PATHWAYS	PERCENT TOTAL
ORGANICS								
Bis(2-ethylhexyl) phthalate	3.14E-04	2.06E-03	2.37E-03				2.37E-03	2.42
Butyl-benzyl phthalate	2.77E-07	1.82E-06	2.09E-06				2.09E-06	0.00
Di-n-butyl phthalate	3.30E-07	2.17E-06	2.50E-06				2.50E-06	0.00
Di-n-octyl phthalate	3.43E-05	2.25E-04	2.59E-04				2.59E-04	0.26
Methylene chloride	9.83E-07	3.59E-06	4.57E-06				4.57E-06	0.00
Methyl ethyl ketone	3.57E-08	1.30E-07	1.66E-07				1.66E-07	0.00
Naphthalene	6.28E-05	4.12E-04	4.75E-04				4.75E-04	0.48
Polycyclic aromatic hydrocarbons (PAHs)								
Acenaphthene	5.47E-07	1.44E-06	1.99E-06				1.99E-06	0.00
Acenaphthylene	1.21E-06	3.18E-06	4.40E-06				4.40E-06	0.00
Anthracene	1.76E-07	4.62E-07	6.38E-07				6.38E-07	0.00
Benzo (a) anthracene	3.03E-06	7.97E-06	1.10E-05				1.10E-05	0.01
Benzo(a)pyrene	2.72E-06	7.15E-06	9.87E-06				9.87E-06	0.01
Benzo(b)fluoranthene/Benzo(k)fluoranthene	4.04E-06	1.06E-05	1.47E-05				1.47E-05	0.01
Benzo(g,h,i)perylene	2.25E-06	5.92E-06	8.17E-06				8.17E-06	0.01
Chrysene	3.32E-06	8.72E-06	1.20E-05				1.20E-05	0.01
Dibenzo(a,h)anthracene	1.13E-06	2.96E-06	4.08E-06				4.08E-06	0.00
Fluoranthene	3.38E-06	8.88E-06	1.23E-05				1.23E-05	0.01
Fluorene	1.16E-06	3.06E-06	4.22E-06				4.22E-06	0.00
Indeno(1,2,3,c,d) pyrene	1.81E-06	4.75E-06	6.56E-06				6.56E-06	0.01
2-Methylnaphthalene	6.67E-07	1.75E-06	2.42E-06				2.42E-06	0.00
Phenanthrene	3.89E-06	1.02E-05	1.41E-05				1.41E-05	0.01
Pyrene	4.33E-06	1.14E-05	1.57E-05				1.57E-05	0.02
Tetrachloroethene	3.56E-08	1.30E-06	1.33E-06				1.33E-06	0.00
Toluene	7.50E-09	2.74E-07	2.81E-07				2.81E-07	0.00
Xylenes (total)	7.50E-10	2.74E-08	2.81E-08				2.81E-08	0.00

TABLE 5 12. AVERAGE HAZARD INDEX - WADER/SWIMMER (continued)

CHEMICAL	SEDIMENTS PATHWAY			SURFACE WATER PATHWAY			WADER/SWIMMER TOTAL INDICES	
	INGESTION	DERMAL	PATHWAY TOTAL	INGESTION	DERMAL	PATHWAY TOTAL	ALL PATHWAYS	PERCENT TOTAL
INORGANICS								
Aluminum	1.51E-04	0.00E+00	1.51E-04				1.51E-04	0.15
Antimony	2.09E-02	0.00E+00	2.09E-02				2.09E-02	21.36
Arsenic	7.91E-03	0.00E+00	7.91E-03	4.83E-03	1.43E-02	1.91E-02	2.70E-02	27.61
Barium	2.03E-05	0.00E+00	2.03E-05	1.93E-03	5.72E-03	7.66E-03	7.68E-03	7.84
Cadmium	2.70E-04	0.00E+00	2.70E-04				2.70E-04	0.28
Calcium	2.09E-06	0.00E+00	2.09E-06	8.33E-04	3.08E-04	1.14E-03	1.14E-03	1.17
Chromium III	2.77E-06	0.00E+00	2.77E-06	7.28E-06	2.15E-05	2.88E-05	3.16E-05	0.03
Chromium VI	1.98E-04	0.00E+00	1.98E-04	2.08E-04	6.16E-04	8.24E-04	1.02E-03	1.04
Cobalt	6.47E-05	0.00E+00	6.47E-05				6.47E-05	0.07
Copper	2.35E-03	0.00E+00	2.35E-03				2.35E-03	2.40
Iron	1.36E-05	0.00E+00	1.36E-05	7.13E-04	2.11E-03	2.82E-03	2.84E-03	2.89
Lead	0.00E+00	0.00E+00	0.00E+00				0.00E+00	0.00
Magnesium	3.67E-06	0.00E+00	3.67E-06	1.24E-03	4.57E-04	1.69E-03	1.70E-03	1.73
Manganese	5.32E-07	0.00E+00	5.32E-07	5.45E-05	1.61E-04	2.16E-04	2.16E-04	0.22
Mercury	1.17E-03	0.00E+00	1.17E-03				1.17E-03	1.19
Nickel	8.65E-04	0.00E+00	8.65E-04				8.65E-04	0.88
Potassium	1.50E-06	0.00E+00	1.50E-06				1.50E-06	0.00
Selenium				1.47E-03	4.34E-03	5.80E-03	5.80E-03	5.92
Sodium	2.04E-07	0.00E+00	2.04E-07	1.90E-04	3.13E-05	2.22E-04	2.22E-04	0.23
Vanadium	6.12E-05	0.00E+00	6.12E-05	5.02E-03	1.49E-02	1.99E-02	2.00E-02	20.37
Zinc	1.29E-03	0.00E+00	1.29E-03				1.29E-03	1.32
ROUTE TOTAL INDEX	3.57E-02	2.80E-03	3.85E-02	1.65E-02	4.29E-02	5.94E-02	9.80E-02	100.00
PERCENT TOTAL RISK	36.48	2.85	39.33	16.84	43.83	60.67	100.00	

TABLE 5-13. UPPER 95 HAZARD INDEX - WADER/SWIMMER

CHEMICAL	SEDIMENTS PATHWAY			SURFACE WATER PATHWAY			WADER/SWIMMER TOTAL INDICES	
	INGESTION	DERMAL	PATHWAY TOTAL	INGESTION	DERMAL	PATHWAY TOTAL	ALL PATHWAYS	PERCENT TOTAL
ORGANICS								
Bis(2-ethylhexyl) phthalate	3.80E-03	2.50E-02	2.88E-02				2.88E-02	1.98
Butyl-benzyl phthalate	4.60E-07	3.02E-06	3.48E-06				3.48E-06	0.00
Di-n-butyl phthalate	2.30E-06	1.51E-05	1.74E-05				1.74E-05	0.00
Di-n-octyl phthalate	1.05E-04	6.90E-04	7.95E-04					
Methylene chloride	9.83E-07	3.59E-06	4.57E-06				4.57E-06	0.00
Methyl ethyl ketone	1.06E-07	3.87E-07	4.93E-07				4.93E-07	0.00
Naphthalene	1.72E-04	1.19E-03	1.31E-03				1.31E-03	0.09
Polycyclic aromatic hydrocarbons (PAHs)								
Acenaphthene	1.20E-06	3.15E-06	4.35E-06				4.35E-06	0.00
Acenaphthylene	1.63E-06	4.29E-06	5.93E-06				5.93E-06	0.00
Anthracene	8.67E-07	2.28E-06	3.14E-06				3.14E-06	0.00
Benzo (a) anthracene	2.13E-05	5.61E-05	7.74E-05				7.74E-05	0.01
Benzo(a)pyrene	1.67E-05	4.38E-05	6.05E-05				6.05E-05	0.00
Benzo(b)fluoranthene/Benzo(k)fluoranthene	2.73E-05	7.18E-05	9.92E-05				9.92E-05	0.01
Benzo(g,h,i)perylene	1.10E-05	2.89E-05	3.99E-05				3.99E-05	0.00
Chrysene	2.17E-05	5.69E-05	7.86E-05				7.86E-05	0.01
Dibenzo(a,h)anthracene	4.67E-06	1.23E-05	1.69E-05				1.69E-05	0.00
Fluoranthene	3.50E-05	9.20E-05	1.27E-04				1.27E-04	0.01
Fluorene	2.44E-06	6.42E-06	8.87E-06				8.87E-06	0.00
Indeno(1,2,3,c,d) pyrene	8.33E-06	2.19E-05	3.02E-05				3.02E-05	0.00
2-Methylnapthalene	6.67E-07	1.75E-06	2.42E-06					
Phenanthrene	3.33E-05	8.76E-05	1.21E-04				1.21E-04	0.01
Pyrene	4.33E-05	1.14E-04	1.57E-04				1.57E-04	0.01
Tetrachloroethene	8.75E-06	3.19E-06	3.28E-06				3.28E-06	0.00
Toluene	7.50E-09	2.74E-07	2.81E-07				2.81E-07	0.00
Xylenes (total)	7.50E-10	2.74E-06	2.81E-06				2.81E-06	0.00

TABLE 5-13. UPPER 95 HAZARD INDEX - WADER/SWIMMER (continued)

CHEMICAL	SEDIMENTS PATHWAY			SURFACE WATER PATHWAY			WADER/SWIMMER TOTAL INDICES	
	INGESTION	DERMAL	PATHWAY TOTAL	INGESTION	DERMAL	PATHWAY TOTAL	ALL PATHWAYS	PERCENT TOTAL
INORGANICS								
Aluminum	1.27E-01	0.00E+00	1.27E-01				1.27E-01	8.77
Antimony	1.07E+00	0.00E+00	1.07E+00				1.07E+00	73.97
Arsenic	1.19E-02	0.00E+00	1.19E-02	4.90E-03	1.45E-02	1.94E-02	3.13E-02	2.15
Barium	2.06E-03	0.00E+00	2.06E-03	4.00E-03	1.18E-02	1.58E-02	1.79E-02	1.23
Cadmium	5.00E-03	0.00E+00	5.00E-03				5.00E-03	0.34
Calcium	1.90E-04	0.00E+00	1.90E-04	3.00E-03	1.11E-03	4.11E-03	4.30E-03	0.30
Chromium III	3.33E-06	0.00E+00	3.33E-06	1.40E-05	4.14E-05	5.54E-05	5.88E-05	0.00
Chromium VI	2.38E-04	0.00E+00	2.38E-04	4.00E-04	1.18E-03	1.58E-03	1.82E-03	0.13
Cobalt	2.29E-03	0.00E+00	2.29E-03				2.29E-03	0.16
Copper	1.06E-02	0.00E+00	1.06E-02				1.06E-02	0.73
Iron	6.65E-02	0.00E+00	6.65E-02	2.39E-03	7.07E-03	9.46E-03	7.60E-02	5.23
Lead	0.00E+00	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00
Magnesium	2.58E-04	0.00E+00	2.58E-04	2.45E-03	9.06E-04	3.36E-03	3.61E-03	0.25
Manganese	6.70E-04	0.00E+00	6.70E-04	1.80E-04	5.32E-04	7.11E-04	1.38E-03	0.10
Mercury	8.33E-03	0.00E+00	8.33E-03				8.33E-03	0.57
Nickel	9.45E-04	0.00E+00	9.45E-04				9.45E-04	0.07
Potassium	3.44E-05	0.00E+00	3.44E-05				3.44E-05	0.00
Selenium				1.67E-03	4.93E-03	6.60E-03	6.60E-03	0.45
Sodium	2.98E-06	0.00E+00	2.98E-06	6.09E-04	1.00E-04	7.09E-04	7.12E-04	0.05
Vanadium	1.80E-02	0.00E+00	1.80E-02	7.14E-03	2.11E-02	2.83E-02	4.63E-02	3.18
Zinc	2.74E-03	0.00E+00	2.74E-03				2.74E-03	0.19
ROUTE TOTAL INDEX	1.34E+00	2.74E-02	1.36E+00	2.87E-02	8.34E-02	9.01E-02	1.45E+00	100.00
PERCENT TOTAL RISK	91.97	1.89	93.86		4.96	6.20	100.00	

TABLE 5-14. AVERAGE AND UPPER 95 HAZARD INDICES - FISH INGESTION

CHEMICAL	AVERAGE		UPPER 95	
	ADULT	CHILD	ADULT	CHILD
INORGANICS				
Arsenic	6.52E-01	1.52E+00	6.61E-01	1.54E+00
Chromium III	3.57E-04	8.32E-04	6.86E-04	1.60E-03
Chromium VI	1.24E-02	2.88E-02	2.38E-02	5.54E-02
Selenium	9.04E-03	2.11E-02	1.03E-02	2.40E-02
TOTAL	6.74E-01	1.57E+00	6.86E-01	1.62E+00

TABLE 5-15. AVERAGE LIFETIME CARCINOGENIC RISK (SUM OF ADULT AND CHILD RESIDENT) - ALL PATHWAYS, FUTURE USE ONLY

CHEMICAL	GROUNDWATER SHALLOW	GROUNDWATER INTERMEDIATE	GROUNDWATER DEEP	SOIL	SEDIMENTS	SURFACE WATER	FISH INGESTION	TOTAL USING SHALLOW GROUNDWATER	TOTAL USING INTERMEDIATE GROUNDWATER	TOTAL USING DEEP GROUNDWATER
ORGANICS										
Aroclor 1254	0.00E+00	0.00E+00	0.00E+00	2.29E-05	0.00E+00	0.00E+00		2.29E-05	2.29E-05	2.29E-05
Benzene	0.00E+00	0.00E+00	0.00E+00	3.18E-08	0.00E+00	0.00E+00		3.18E-08	3.18E-08	3.18E-08
Bis(2-ethylhexyl) phthalate	3.41E-05	1.20E-06	3.13E-06	1.37E-05	4.07E-09	0.00E+00		4.78E-05	1.49E-05	1.68E-05
1,1-Dichloroethane	1.69E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		1.69E-05	0.00E+00	0.00E+00
1,2-Dichloroethane	0.00E+00	0.00E+00	4.18E-06	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00	4.18E-06
1,1-Dichloroethene	8.99E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		8.99E-05	0.00E+00	0.00E+00
Methylene chloride	9.49E-06	0.00E+00	0.00E+00	3.75E-08	1.26E-11	0.00E+00		9.53E-06	3.75E-08	3.75E-08
Polycyclic aromatic hydrocarbons (PAHs)										
Benzo (a) anthracene	0.00E+00	0.00E+00	0.00E+00	4.27E-06	2.32E-07	0.00E+00		4.50E-06	4.50E-06	4.50E-06
Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	3.79E-06	2.09E-07	0.00E+00		3.99E-06	3.99E-06	3.99E-06
Benzo(b)fluoranthene/Benzo(k)fluoranthene	0.00E+00	0.00E+00	0.00E+00	5.65E-06	3.10E-07	0.00E+00		5.96E-06	5.96E-06	5.96E-06
Benzo(g,h,i)perylene	0.00E+00	0.00E+00	0.00E+00	2.16E-08	1.06E-09	0.00E+00		2.27E-08	2.27E-08	2.27E-08
Chrysene	0.00E+00	0.00E+00	0.00E+00	4.21E-06	2.54E-07	0.00E+00		4.46E-06	4.46E-06	4.46E-06
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00	0.00E+00	1.92E-06	8.63E-08	0.00E+00		2.00E-06	2.00E-06	2.00E-06
Indeno(1,2,3,c,d) pyrene	0.00E+00	0.00E+00	0.00E+00	3.40E-06	1.39E-07	0.00E+00		3.54E-06	3.54E-06	3.54E-06
Pyrene	0.00E+00	0.00E+00	0.00E+00	1.04E-07	7.50E-09	0.00E+00		1.12E-07	1.12E-07	1.12E-07
Tetrachloroethene	2.62E-06	0.00E+00	0.00E+00	5.42E-09	4.16E-11	0.00E+00		2.63E-06	5.47E-09	5.47E-09
Trichloroethene	1.42E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		1.42E-06	0.00E+00	0.00E+00
INORGANICS										
Arsenic	1.92E-04	1.09E-04	0.00E+00	0.00E+00	8.48E-08	2.05E-07	6.19E-04	8.11E-04	7.28E-04	6.19E-04
Beryllium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00
Cadmium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00
Chromium VI	0.00E+00	0.00E+00	0.00E+00	7.72E-07	0.00E+00	0.00E+00		7.72E-07	7.72E-07	7.72E-07
Nickel	0.00E+00	0.00E+00	0.00E+00	8.03E-08	0.00E+00	0.00E+00		8.03E-08	8.03E-08	8.03E-08
TOTAL PATHWAY RISK	3.46E-04	1.10E-04	7.31E-06	6.08E-05	1.33E-06	2.05E-07	6.19E-04	1.03E-03	7.92E-04	6.89E-04
PERCENT TOTAL RISK (SHALLOW GROUNDWATER USE)	33.71			5.92	0.13	0.02	60.23	100.00		
PERCENT TOTAL RISK (INTERMEDIATE GROUNDWATER USE)		13.92		7.69	0.17	0.03	78.20		100.00	
PERCENT TOTAL RISK (DEEP GROUNDWATER USE)			1.06	8.83	0.19	0.03	89.88			100.00

TABLE 5-16. UPPER 95 LIFETIME CARCINOGENIC RISK (SUM OF ADULT AND CHILD RESIDENT) - ALL PATHWAYS, FUTURE USE ONLY

CHEMICAL	GROUNDWATER SHALLOW	GROUNDWATER INTERMEDIATE	GROUNDWATER DEEP	SOIL	SEDIMENTS	SURFACE WATER	FISH INGESTION	TOTAL USING SHALLOW GROUNDWATER	TOTAL USING INTERMEDIATE GROUNDWATER	TOTAL USING DEEP GROUNDWATER
ORGANICS										
Aroclor 1254	0.00E+00	0.00E+00	0.00E+00	1.79E-04	0.00E+00	0.00E+00		1.79E-04	1.79E-04	1.79E-04
Benzene	0.00E+00	0.00E+00	0.00E+00	3.18E-05	0.00E+00	0.00E+00		3.18E-05	3.18E-05	3.18E-05
Bis(2-ethylhexyl) phthalate	1.35E-02	7.01E-06	3.91E-04	2.98E-03	4.93E-06	0.00E+00		1.65E-02	2.99E-03	3.37E-03
1,1-Dichloroethane	2.94E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		2.94E-04	0.00E+00	0.00E+00
1,2-Dichloroethane	0.00E+00	0.00E+00	4.80E-06	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00	4.80E-06
1,1-Dichloroethene	1.07E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		1.07E-04	0.00E+00	0.00E+00
Methylene chloride	3.24E-04	0.00E+00	0.00E+00	7.43E-05	1.26E-11	0.00E+00		3.98E-04	7.43E-05	7.43E-05
Polycyclic aromatic hydrocarbons (PAHs)										
Benzo (a) anthracene	0.00E+00	0.00E+00	0.00E+00	9.53E-06	1.63E-06	0.00E+00		1.12E-05	1.12E-05	1.12E-05
Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	6.72E-06	1.26E-06	0.00E+00		8.00E-06	8.00E-06	8.00E-06
Benzo(b)fluoranthene/Benzo(k)fluoranthene	0.00E+00	0.00E+00	0.00E+00	1.23E-05	2.09E-06	0.00E+00		1.44E-05	1.44E-05	1.44E-05
Benzo(g,h,i)perylene	0.00E+00	0.00E+00	0.00E+00	3.84E-06	5.19E-09	0.00E+00		4.36E-06	4.36E-06	4.36E-06
Chrysene	0.00E+00	0.00E+00	0.00E+00	9.22E-06	1.66E-06	0.00E+00		1.09E-05	1.09E-05	1.09E-05
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00	0.00E+00	2.21E-06	3.58E-07	0.00E+00		2.57E-06	2.57E-06	2.57E-06
Indeno(1,2,3,c,d) pyrene	0.00E+00	0.00E+00	0.00E+00	5.31E-06	6.39E-07	0.00E+00		5.95E-06	5.95E-06	5.95E-06
Pyrene	0.00E+00	0.00E+00	0.00E+00	2.37E-07	7.51E-08	0.00E+00		3.12E-07	3.12E-07	3.12E-07
Tetrachloroethene	3.00E-06	0.00E+00	0.00E+00	6.06E-09	1.02E-10	0.00E+00		3.01E-06	6.16E-09	6.16E-09
Trichloroethene	1.71E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		1.71E-06	0.00E+00	0.00E+00
INORGANICS										
Arsenic	4.84E-04	1.21E-04	0.00E+00	0.00E+00	1.28E-07	2.08E-07	6.29E-04	1.11E-03	7.50E-04	6.29E-04
Beryllium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00
Cadmium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00
Chromium VI	0.00E+00	0.00E+00	0.00E+00	1.42E-06	0.00E+00	0.00E+00		1.42E-06	1.42E-06	1.42E-06
Nickel	0.00E+00	0.00E+00	0.00E+00	1.32E-07	0.00E+00	0.00E+00		1.32E-07	1.32E-07	1.32E-07
TOTAL PATHWAY RISK	1.47E-02	1.26E-04	3.96E-04	3.31E-03	7.92E-06	2.08E-07	6.29E-04	1.87E-02	4.08E-03	4.35E-03
PERCENT TOTAL RISK (SHALLOW GROUNDWATER USE)	78.84			17.75	0.04	0.00	3.37	100.00		
PERCENT TOTAL RISK (INTERMEDIATE GROUNDWATER USE)		3.14		81.24	0.19	0.01	15.43		100.00	
PERCENT TOTAL RISK (DEEP GROUNDWATER USE)			9.11	76.23	0.18	0.00	14.48			100.00

28-May-91 L.E. CARPENTER

TABLE 5-17. AVERAGE HAZARD INDEX - ADULT

CHEMICAL	GROUNDWATER SHALLOW	GROUNDWATER INTERMEDIATE	GROUNDWATER DEEP	SOIL	FISH INGESTION	TOTAL USING SHALLOW GROUNDWATER	TOTAL USING INTERMEDIATE GROUNDWATER	TOTAL USING DEEP GROUNDWATER
ORGANICS								
Acetone	0.00E+00	0.00E+00	0.00E+00	4.07E-05	0.00E+00	4.07E-05	4.07E-05	4.07E-05
Aroclor 1254	0.00E+00	0.00E+00	0.00E+00	4.73E-01	0.00E+00	4.73E-01	4.73E-01	4.73E-01
Benzene	0.00E+00	0.00E+00	0.00E+00	1.28E-03	0.00E+00	1.28E-03	1.28E-03	1.28E-03
Bis(2-ethylhexyl) phthalate	2.24E-01	7.88E-03	2.06E-02	5.45E-02	0.00E+00	2.78E-01	6.23E-02	7.51E-02
Butyl-benzyl phthalate	1.96E-03	0.00E+00	0.00E+00	7.71E-06	0.00E+00	1.97E-03	7.71E-06	7.71E-06
1,1-Dichloroethane	3.42E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.42E-03	0.00E+00	0.00E+00
1,2-Dichloroethane	0.00E+00	0.00E+00	6.75E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.75E-03
1,1-Dichloroethene	3.27E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.27E-02	0.00E+00	0.00E+00
1,2-Dichloroethene (total)	6.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.08E-03	0.00E+00	0.00E+00
1,2-Diethylbenzene	5.60E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.60E-03	0.00E+00	0.00E+00
Diethylphthalate	0.00E+00	0.00E+00	7.86E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.86E-05
2,4-Dimethylphenol	1.57E-02	1.06E-02	0.00E+00	0.00E+00	0.00E+00	1.57E-02	1.06E-02	0.00E+00
Di-n-butyl phthalate	2.95E-03	0.00E+00	0.00E+00	1.78E-05	0.00E+00	2.97E-03	1.78E-05	1.78E-05
Di-n-octyl phthlate	1.98E-02	0.00E+00	0.00E+00	2.08E-04	0.00E+00	2.00E-02	2.08E-04	2.08E-04
Ethylbenzene	1.63E-02	1.32E-03	0.00E+00	4.74E-06	0.00E+00	1.63E-02	1.33E-03	4.74E-06
1-ethyl-3-methylbenzene	9.68E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.68E-03	0.00E+00	0.00E+00
Isopropyl benzene (cumene)	8.99E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.99E-03	0.00E+00	0.00E+00
Methylene chloride	1.44E-02	0.00E+00	0.00E+00	9.74E-05	0.00E+00	1.45E-02	9.74E-05	9.74E-05
Methyl ethyl ketone	0.00E+00	0.00E+00	0.00E+00	2.42E-06	0.00E+00	2.42E-06	2.42E-06	2.42E-06
Naphthalene	1.61E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.61E-02	0.00E+00	0.00E+00
n-Butylbenzene	3.80E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.80E-03	0.00E+00	0.00E+00
n-Decane	3.34E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.34E-03	0.00E+00	0.00E+00
n-Nonane	3.62E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.62E-04	0.00E+00	0.00E+00
Polycyclic aromatic hydrocarbons (PAHs)								
Benzo (a) anthracene	0.00E+00	0.00E+00	0.00E+00	1.30E-05	0.00E+00	1.30E-05	1.30E-05	1.30E-05
Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	1.16E-05	0.00E+00	1.16E-05	1.16E-05	1.16E-05
Benzo(b)fluoranthene/Benzo(k)fluoranthene	0.00E+00	0.00E+00	0.00E+00	1.73E-05	0.00E+00	1.73E-05	1.73E-05	1.73E-05
Benzo(g,h,i)perylene	0.00E+00	0.00E+00	0.00E+00	1.07E-05	0.00E+00	1.07E-05	1.07E-05	1.07E-05
Chrysene	0.00E+00	0.00E+00	0.00E+00	1.28E-05	0.00E+00	1.28E-05	1.28E-05	1.28E-05
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00	0.00E+00	5.86E-06	0.00E+00	5.86E-06	5.86E-06	5.86E-06
Fluoranthene	0.00E+00	0.00E+00	0.00E+00	5.68E-06	0.00E+00	5.68E-06	5.68E-06	5.68E-06
Indeno(1,2,3,c,d) pyrene	0.00E+00	0.00E+00	0.00E+00	1.04E-05	0.00E+00	1.04E-05	1.04E-05	1.04E-05

TABLE 5-17. AVERAGE HAZARD INDEX - ADULT (continued)

CHEMICAL	GROUNDWATER SHALLOW	GROUNDWATER INTERMEDIATE	GROUNDWATER DEEP	SOIL	FISH INGESTION	TOTAL USING SHALLOW GROUNDWATER	TOTAL USING INTERMEDIATE GROUNDWATER	TOTAL USING DEEP GROUNDWATER
Phenanthrene	0.00E+00	0.00E+00	0.00E+00	1.30E-05	0.00E+00	1.30E-05	1.30E-05	1.30E-05
Pyrene	0.00E+00	0.00E+00	0.00E+00	1.41E-05	0.00E+00	1.41E-05	1.41E-05	1.41E-05
Phenol	4.99E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.99E-04	0.00E+00	0.00E+00
Tetrachloroethene	9.40E-03	0.00E+00	0.00E+00	1.24E-05	0.00E+00	9.42E-03	1.24E-05	1.24E-05
1,2,3,4-Tetramethylbenzene	3.55E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.55E-03	0.00E+00	0.00E+00
Toluene	1.18E-03	0.00E+00	0.00E+00	3.75E-07	0.00E+00	1.18E-03	3.75E-07	3.75E-07
1,1,1-Trichloroethane	1.16E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E-03	0.00E+00	0.00E+00
Trichloroethene	1.30E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.30E-02	0.00E+00	0.00E+00
1,2,3-Trimethylbenzene/1,2,4-Trimethylbenzene	2.19E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.19E-02	0.00E+00	0.00E+00
1,3,5-Trimethylbenzene	1.29E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.29E-02	0.00E+00	0.00E+00
Xylenes (total)	4.85E-02	1.76E-03	0.00E+00	1.19E-06	0.00E+00	4.85E-02	1.76E-03	1.19E-06
INORGANICS								
Antimony	6.58E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.58E+00	0.00E+00	0.00E+00
Arsenic	2.03E-01	1.15E-01	0.00E+00	0.00E+00	6.52E-01	8.55E-01	7.67E-01	6.52E-01
Cadmium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chromium III	0.00E+00	1.77E-04	1.31E-04	3.28E-04	3.57E-04	6.85E-04	8.62E-04	8.16E-04
Chromium VI	0.00E+00	5.06E-03	3.75E-03	1.17E-03	1.24E-02	1.36E-02	1.86E-02	1.73E-02
Copper	9.15E-03	5.07E-03	4.70E-03	2.22E-03	0.00E+00	1.14E-02	7.29E-03	6.92E-03
Lead	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mercury	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nickel	7.79E-03	6.10E-02	0.00E+00	2.03E-03	0.00E+00	9.82E-03	6.30E-02	2.03E-03
Selenium	2.58E-02	2.37E-02	0.00E+00	0.00E+00	9.04E-03	3.48E-02	3.27E-02	9.04E-03
Thallium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zinc	9.26E-03	4.20E-03	3.10E-03	1.15E-03	0.00E+00	1.04E-02	5.35E-03	4.25E-03
Cyanide	0.00E+00	0.00E+00	0.00E+00	3.37E-03	0.00E+00	3.37E-03	3.37E-03	3.37E-03
TOTAL PATHWAY RISK	7.33	0.24	0.04	0.54	0.67	8.55	1.45	1.25
PERCENT TOTAL RISK (SHALLOW GROUNDWATER USE)	85.81			6.31	7.88	100.00		
PERCENT TOTAL RISK (INTERMEDIATE GROUNDWATER USE)		16.28		37.21	46.51		100.00	
PERCENT TOTAL RISK (DEEP GROUNDWATER USE)			3.12	43.06	53.82			100.00

TABLE 5-18. UPPER 95 HAZARD INDEX - ADULT

CHEMICAL	GROUNDWATER SHALLOW	GROUNDWATER INTERMEDIATE	GROUNDWATER DEEP	SOIL	FISH INGESTION	TOTAL USING SHALLOW GROUNDWATER	TOTAL USING INTERMEDIATE GROUNDWATER	TOTAL USING DEEP GROUNDWATER
ORGANICS								
Acetone	0.00E+00	0.00E+00	0.00E+00	3.21E-02	0.00E+00	3.21E-02	3.21E-02	3.21E-02
Aroclor 1254	0.00E+00	0.00E+00	0.00E+00	3.69E+00	0.00E+00	3.69E+00	3.69E+00	3.69E+00
Benzene	0.00E+00	0.00E+00	0.00E+00	1.28E+00	0.00E+00	1.28E+00	1.28E+00	1.28E+00
Bis(2-ethylhexyl) phthalate	8.86E+01	4.61E-02	2.57E+00	1.19E+01	0.00E+00	1.00E+02	1.19E+01	1.45E+01
Butyl-benzyl phthalate	2.37E-02	0.00E+00	0.00E+00	1.81E-04	0.00E+00	2.39E-02	1.81E-04	1.81E-04
1,1-Dichloroethane	5.94E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.94E-02	0.00E+00	0.00E+00
1,2-Dichloroethane	0.00E+00	0.00E+00	7.75E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.75E-03
1,1-Dichloroethene	3.88E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.88E-02	0.00E+00	0.00E+00
1,2-Dichloroethene (total)	2.05E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-02	0.00E+00	0.00E+00
1,2-Diethylbenzene	1.43E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E-02	0.00E+00	0.00E+00
Diethylphthalate	0.00E+00	0.00E+00	7.86E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.86E-05
2,4-Dimethylphenol	1.14E-01	3.90E-02	0.00E+00	0.00E+00	0.00E+00	1.14E-01	3.90E-02	0.00E+00
Di-n-butyl phthalate	1.04E-02	0.00E+00	0.00E+00	5.36E-05	0.00E+00	1.05E-02	5.36E-05	5.36E-05
Di-n-octyl phthlate	2.43E-01	0.00E+00	0.00E+00	1.61E-03	0.00E+00	2.45E-01	1.61E-03	1.61E-03
Ethylbenzene	9.11E+00	1.26E-02	0.00E+00	6.35E-01	0.00E+00	9.74E+00	6.47E-01	6.35E-01
1-ethyl-3-methylbenzene	2.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.40E-01	0.00E+00	0.00E+00
Isopropyl benzene (cumene)	3.61E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.61E-02	0.00E+00	0.00E+00
Methylene chloride	4.94E-01	0.00E+00	0.00E+00	1.93E-01	0.00E+00	6.87E-01	1.93E-01	1.93E-01
Methyl ethyl ketone	0.00E+00	0.00E+00	0.00E+00	1.84E-04	0.00E+00	1.84E-04	1.84E-04	1.84E-04
Naphthalene	1.85E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.85E-02	0.00E+00	0.00E+00
n-Butylbenzene	5.99E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.99E-03	0.00E+00	0.00E+00
n-Decane	4.22E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.22E-01	0.00E+00	0.00E+00
n-Nonane	5.26E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.26E-03	0.00E+00	0.00E+00
Polycyclic aromatic hydrocarbons (PAHs)								
Benzo (a) anthracene	0.00E+00	0.00E+00	0.00E+00	2.91E-05	0.00E+00	2.91E-05	2.91E-05	2.91E-05
Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	2.05E-05	0.00E+00	2.05E-05	2.05E-05	2.05E-05
Benzo(b)fluoranthene/Benzo(k)fluoranthene	0.00E+00	0.00E+00	0.00E+00	3.77E-05	0.00E+00	3.77E-05	3.77E-05	3.77E-05
Benzo(g,h,i)perylene	0.00E+00	0.00E+00	0.00E+00	1.90E-05	0.00E+00	1.90E-05	1.90E-05	1.90E-05
Chrysene	0.00E+00	0.00E+00	0.00E+00	2.82E-05	0.00E+00	2.82E-05	2.82E-05	2.82E-05
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00	0.00E+00	6.76E-06	0.00E+00	6.76E-06	6.76E-06	6.76E-06
Fluoranthene	0.00E+00	0.00E+00	0.00E+00	2.35E-05	0.00E+00	2.35E-05	2.35E-05	2.35E-05
Indeno(1,2,3,c,d) pyrene	0.00E+00	0.00E+00	0.00E+00	1.62E-05	0.00E+00	1.62E-05	1.62E-05	1.62E-05

TABLE 5-18. UPPER 95 HAZARD INDEX - ADULT

CHEMICAL	GROUNDWATER SHALLOW	GROUNDWATER INTERMEDIATE	GROUNDWATER DEEP	SOIL	FISH INGESTION	TOTAL USING SHALLOW GROUNDWATER	TOTAL USING INTERMEDIATE GROUNDWATER	TOTAL USING DEEP GROUNDWATER
Phenanthrene	0.00E+00	0.00E+00	0.00E+00	3.71E-05	0.00E+00	3.71E-05	3.71E-05	3.71E-05
Pyrene	0.00E+00	0.00E+00	0.00E+00	3.20E-05	0.00E+00	3.20E-05	3.20E-05	3.20E-05
Phenol	2.32E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.32E-03	0.00E+00	0.00E+00
Tetrachloroethene	1.08E-02	0.00E+00	0.00E+00	1.39E-05	0.00E+00	1.08E-02	1.39E-05	1.39E-05
1,2,3,4-Tetramethylbenzene	9.69E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.69E-03	0.00E+00	0.00E+00
Toluene	1.60E-02	0.00E+00	0.00E+00	1.28E-06	0.00E+00	1.60E-02	1.28E-06	1.28E-06
1,1,1-Trichloroethane	1.24E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.24E-03	0.00E+00	0.00E+00
Trichloroethene	1.57E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00	0.00E+00
1,2,3-Trimethylbenzene/1,2,4-Trimethylbenzene	2.33E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.33E-01	0.00E+00	0.00E+00
1,3,5-Trimethylbenzene	2.81E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.81E-01	0.00E+00	0.00E+00
Xylenes (total)	4.17E+01	1.24E-01	0.00E+00	1.39E-01	0.00E+00	4.18E+01	2.63E-01	1.39E-01
INORGANICS								
Antimony	3.45E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.45E+01	0.00E+00	0.00E+00
Arsenic	5.10E-01	1.27E-01	0.00E+00	0.00E+00	6.61E-01	1.17E+00	7.88E-01	6.61E-01
Cadmium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chromium III	0.00E+00	9.80E-04	3.18E-04	6.05E-04	6.86E-04	1.29E-03	2.27E-03	1.61E-03
Chromium VI	0.00E+00	2.80E-02	9.07E-03	2.15E-03	2.38E-02	2.59E-02	5.39E-02	3.50E-02
Copper	2.05E-02	8.24E-03	8.78E-03	4.16E-03	0.00E+00	2.47E-02	1.24E-02	1.29E-02
Lead	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mercury	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nickel	1.00E-01	1.46E+00	0.00E+00	3.33E-03	0.00E+00	1.03E-01	1.46E+00	3.33E-03
Selenium	3.75E-02	2.38E-02	0.00E+00	0.00E+00	1.03E-02	4.78E-02	3.41E-02	1.03E-02
Thallium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zinc	2.99E-02	3.27E-02	5.00E-02	2.33E-03	0.00E+00	3.22E-02	3.50E-02	5.23E-02
Cyanide	0.00E+00	0.00E+00	0.00E+00	4.63E-03	0.00E+00	4.63E-03	4.63E-03	4.63E-03
TOTAL PATHWAY RISK	1.77E+02	1.90E+00	2.65E+00	1.79E+01	6.96E-01	1.96E+02	2.05E+01	2.12E+01
PERCENT TOTAL RISK (SHALLOW GROUNDWATER USE)	90.50			9.15	0.36	100.00		
PERCENT TOTAL RISK (INTERMEDIATE GROUNDWATER USE)		9.29		87.31	3.40		100.00	
PERCENT TOTAL RISK (DEEP GROUNDWATER USE)			12.47	84.25	3.28			100.00

TABLE 5-19. AVERAGE HAZARD INDEX - CHILD

CHEMICALS	GROUNDWATER SHALLOW	GROUNDWATER INTERMEDIATE	GROUNDWATER DEEP	SOIL	SEDIMENTS	SURFACE WATER	FISH INGESTION	TOTAL USING SHALLOW GROUNDWATER	TOTAL USING INTERMEDIATE GROUNDWATER	TOTAL USING DEEP GROUNDWATER
ORGANICS										
Acetone	0.00E+00	0.00E+00	0.00E+00	2.44E-04	0.00E+00	0.00E+00	0.00E+00	2.44E-04	2.44E-04	2.44E-04
Aroclor 1254	0.00E+00	0.00E+00	0.00E+00	3.06E+00	0.00E+00	0.00E+00	0.00E+00	3.06E+00	3.06E+00	3.06E+00
Benzene	0.00E+00	0.00E+00	0.00E+00	7.66E-03	0.00E+00	0.00E+00	0.00E+00	7.66E-03	7.66E-03	7.66E-03
Bis(2-ethylhexyl) phthalate	5.24E-01	1.84E-02	4.80E-02	3.53E-01	2.37E-03	0.00E+00	0.00E+00	8.79E-01	3.74E-01	4.03E-01
Butyl-benzyl phthalate	4.57E-03	0.00E+00	0.00E+00	5.00E-05	2.09E-06	0.00E+00	0.00E+00	4.62E-03	5.20E-05	5.20E-05
1,1-Dichloroethane	8.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.00E-03	0.00E+00	0.00E+00
1,2-Dichloroethane	0.00E+00	0.00E+00	1.57E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.57E-02
1,1-Dichloroethene	7.65E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.65E-02	0.00E+00	0.00E+00
1,2-Dichloroethene (total)	1.41E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.41E-02	0.00E+00	0.00E+00
1,2-Diethylbenzene	1.31E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-02	0.00E+00	0.00E+00
Diethylphthalate	0.00E+00	0.00E+00	1.83E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.83E-04
2,4-Dimethylphenol	3.87E-02	2.47E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.87E-02	2.47E-02	0.00E+00
Di-n-butyl phthalate	6.89E-03	0.00E+00	0.00E+00	1.15E-04	2.50E-06	0.00E+00	0.00E+00	7.01E-03	1.17E-04	1.17E-04
Di-n-octyl phthlate	4.61E-02	0.00E+00	0.00E+00	1.35E-03	2.59E-04	0.00E+00	0.00E+00	4.77E-02	1.61E-03	1.61E-03
Ethylbenzene	3.81E-02	3.09E-03	0.00E+00	2.83E-05	0.00E+00	0.00E+00	0.00E+00	3.81E-02	3.12E-03	2.83E-05
1-ethyl-3-methylbenzene	2.26E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.26E-02	0.00E+00	0.00E+00
Isopropyl benzene (cumene)	2.10E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.10E-02	0.00E+00	0.00E+00
Methylene chloride	3.38E-02	0.00E+00	0.00E+00	5.83E-04	4.57E-06	0.00E+00	0.00E+00	3.44E-02	5.87E-04	5.87E-04
Methyl ethyl ketone	0.00E+00	0.00E+00	0.00E+00	1.45E-05	1.66E-07	0.00E+00	0.00E+00	1.47E-05	1.47E-05	1.47E-05
Naphthalene	4.22E-02	0.00E+00	0.00E+00	0.00E+00	4.75E-04	0.00E+00	0.00E+00	4.27E-02	4.75E-04	4.75E-04
n-Butylbenzene	8.87E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.87E-03	0.00E+00	0.00E+00
n-Decane	7.78E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E-03	0.00E+00	0.00E+00
n-Nonane	8.45E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.45E-04	0.00E+00	0.00E+00
Polycyclic aromatic hydrocarbons (PAHs)										
Acenaphthene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.99E-06	0.00E+00	0.00E+00	1.99E-06	1.99E-06	1.99E-06
Acenaphthylene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.40E-06	0.00E+00	0.00E+00	4.40E-06	4.40E-06	4.40E-06
Anthracene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.38E-07	0.00E+00	0.00E+00	6.38E-07	6.38E-07	6.38E-07
Benzo (a) anthracene	0.00E+00	0.00E+00	0.00E+00	9.24E-05	1.10E-05	0.00E+00	0.00E+00	1.03E-04	1.03E-04	1.03E-04
Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	8.19E-05	9.87E-06	0.00E+00	0.00E+00	9.18E-05	9.18E-05	9.18E-05
Benzo(b)fluoranthene/Benzo(k)fluoranthene	0.00E+00	0.00E+00	0.00E+00	1.22E-04	1.47E-05	0.00E+00	0.00E+00	1.37E-04	1.37E-04	1.37E-04
Benzo(g,h,i)perylene	0.00E+00	0.00E+00	0.00E+00	7.61E-05	8.17E-06	0.00E+00	0.00E+00	8.43E-05	8.43E-05	8.43E-05
Chrysene	0.00E+00	0.00E+00	0.00E+00	9.10E-05	1.20E-05	0.00E+00	0.00E+00	1.03E-04	1.03E-04	1.03E-04
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00	0.00E+00	4.15E-05	4.08E-06	0.00E+00	0.00E+00	4.56E-05	4.56E-05	4.56E-05
Fluoranthene	0.00E+00	0.00E+00	0.00E+00	4.02E-05	1.23E-05	0.00E+00	0.00E+00	5.25E-05	5.25E-05	5.25E-05
Fluorene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.22E-06	0.00E+00	0.00E+00	4.22E-06	4.22E-06	4.22E-06
Indeno(1,2,3,c,d) pyrene	0.00E+00	0.00E+00	0.00E+00	7.36E-05	6.56E-06	0.00E+00	0.00E+00	8.01E-05	8.01E-05	8.01E-05
2-Methylnaphthalene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.42E-06	0.00E+00	0.00E+00	2.42E-06	2.42E-06	2.42E-06
Phenanthrene	0.00E+00	0.00E+00	0.00E+00	9.21E-05	1.41E-05	0.00E+00	0.00E+00	1.06E-04	1.06E-04	1.06E-04
Pyrene	0.00E+00	0.00E+00	0.00E+00	9.99E-05	1.57E-05	0.00E+00	0.00E+00	1.16E-04	1.16E-04	1.16E-04

28-May-91 L.E. CARPENTER

TABLE 5-19. AVERAGE HAZARD INDEX - CHILD

CHEMICALS	GROUNDWATER SHALLOW	GROUNDWATER INTERMEDIATE	GROUNDWATER DEEP	SOIL	SEDIMENTS	SURFACE WATER	FISH INGESTION	TOTAL USING SHALLOW GROUNDWATER	TOTAL USING INTERMEDIATE GROUNDWATER	TOTAL USING DEEP GROUNDWATER
Phenol	1.17E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-03	0.00E+00	0.00E+00
Tetrachloroethene	2.19E-02	0.00E+00	0.00E+00	7.44E-05	1.33E-06	0.00E+00	0.00E+00	2.20E-02	7.57E-05	7.57E-05
1,2,3,4-Tetramethylbenzene	8.28E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.28E-03	0.00E+00	0.00E+00
Toluene	2.76E-03	0.00E+00	0.00E+00	2.24E-06	2.81E-07	0.00E+00	0.00E+00	2.77E-03	2.52E-06	2.52E-06
1,1,1-Trichloroethane	2.71E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.71E-03	0.00E+00	0.00E+00
Trichloroethene	3.05E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.05E-02	0.00E+00	0.00E+00
1,2,3-Trimethylbenzene/1,2,4-Trimethylbenzene	5.10E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.10E-02	0.00E+00	0.00E+00
1,3,5-Trimethylbenzene	3.00E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E-02	0.00E+00	0.00E+00
Xylenes (total)	1.14E-01	4.12E-03	0.00E+00	7.14E-06	2.81E-08	0.00E+00	0.00E+00	1.14E-01	4.13E-03	7.16E-06
INORGANICS										
Aluminum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.51E-04	0.00E+00	0.00E+00	1.51E-04	1.51E-04	1.51E-04
Antimony	1.54E+01	0.00E+00	0.00E+00	0.00E+00	2.09E-02	0.00E+00	0.00E+00	1.54E+01	2.09E-02	2.09E-02
Arsenic	4.73E-01	2.68E-01	0.00E+00	0.00E+00	7.91E-03	1.91E-02	1.52E+00	2.02E+00	1.82E+00	1.55E+00
Barium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.03E-05	7.66E-03	0.00E+00	7.68E-03	7.68E-03	7.68E-03
Beryllium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cadmium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.70E-04	0.00E+00	0.00E+00	2.70E-04	2.70E-04	2.70E-04
Calcium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.09E-06	1.14E-03	0.00E+00	1.14E-03	1.14E-03	1.14E-03
Chromium III	0.00E+00	4.13E-04	3.06E-04	2.05E-03	2.77E-06	2.88E-05	8.32E-04	2.91E-03	3.32E-03	3.22E-03
Chromium VI	0.00E+00	1.18E-02	8.73E-03	9.43E-03	1.98E-04	8.24E-04	2.88E-02	3.93E-02	5.11E-02	4.80E-02
Cobalt	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.47E-05	0.00E+00	0.00E+00	6.47E-05	6.47E-05	6.47E-05
Copper	2.14E-02	1.18E-02	1.10E-02	1.93E-02	2.35E-03	0.00E+00	0.00E+00	4.31E-02	3.35E-02	3.27E-02
Iron	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.36E-05	2.82E-03	0.00E+00	2.84E-03	2.84E-03	2.84E-03
Lead	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Magnesium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.67E-06	1.69E-03	0.00E+00	1.70E-03	1.70E-03	1.70E-03
Manganese	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.32E-07	2.16E-04	0.00E+00	2.16E-04	2.16E-04	2.16E-04
Mercury	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-03	0.00E+00	0.00E+00	1.17E-03	1.17E-03	1.17E-03
Nickel	1.82E-02	1.42E-01	0.00E+00	1.53E-02	8.65E-04	0.00E+00	0.00E+00	3.43E-02	1.58E-01	1.61E-02
Potassium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.50E-06	0.00E+00	0.00E+00	1.50E-06	1.50E-06	1.50E-06
Selenium	6.01E-02	5.52E-02	0.00E+00	0.00E+00	0.00E+00	5.80E-03	2.11E-02	8.70E-02	8.21E-02	2.69E-02
Sodium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.04E-07	2.22E-04	0.00E+00	2.22E-04	2.22E-04	2.22E-04
Thallium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Vanadium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.12E-05	1.99E-02	0.00E+00	2.00E-02	2.00E-02	2.00E-02
Zinc	2.16E-02	9.81E-03	7.23E-03	1.00E-02	1.29E-03	0.00E+00	0.00E+00	3.29E-02	2.11E-02	1.85E-02
Cyanide	0.00E+00	0.00E+00	0.00E+00	1.99E-02	0.00E+00	0.00E+00	0.00E+00	1.99E-02	1.99E-02	1.99E-02
TOTAL PATHWAY RISK	1.72E+01	5.49E-01	9.12E-02	3.50E+00	3.85E-02	5.94E-02	1.57E+00	2.23E+01	5.72E+00	5.28E+00
PERCENT TOTAL RISK (SHALLOW GROUNDWATER USE)	76.85			15.68	0.17	0.27	7.03	100.00		
PERCENT TOTAL RISK (INTERMEDIATE GROUNDWATER USE)		9.60		61.22	0.67	1.04	27.46		100.00	
PERCENT TOTAL RISK (DEEP GROUNDWATER USE)			1.73	66.55	0.73	1.13	29.86			100.00

TABLE 5-20. UPPER 95 HAZARD INDEX - CHILD

CHEMICALS	GROUNDWATER SHALLOW	GROUNDWATER INTERMEDIATE	GROUNDWATER DEEP	SOIL	SEDIMENTS	SURFACE WATER	FISH INGESTION	TOTAL USING SHALLOW GROUNDWATER	TOTAL USING INTERMEDIATE GROUNDWATER	TOTAL USING DEEP GROUNDWATER
ORGANICS										
Acetone	0.00E+00	0.00E+00	0.00E+00	1.92E-01	0.00E+00	0.00E+00	0.00E+00	1.92E-01	1.92E-01	1.92E-01
Aroclor 1254	0.00E+00	0.00E+00	0.00E+00	2.39E+01	0.00E+00	0.00E+00	0.00E+00	2.39E+01	2.39E+01	2.39E+01
Benzene	0.00E+00	0.00E+00	0.00E+00	7.66E+00	0.00E+00	0.00E+00	0.00E+00	7.66E+00	7.66E+00	7.66E+00
Bis(2-ethylhexyl) phthalate	2.07E+02	1.08E-01	6.01E+00	7.70E+01	2.88E-02	0.00E+00	0.00E+00	2.84E+02	7.71E+01	8.30E+01
Butyl-benzyl phthalate	5.54E-02	0.00E+00	0.00E+00	1.17E-03	3.48E-06	0.00E+00	0.00E+00	5.66E-02	1.16E-03	1.16E-03
1,1-Dichloroethane	1.38E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E-01	0.00E+00	0.00E+00
1,2-Dichloroethane	0.00E+00	0.00E+00	1.81E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E-02
1,1-Dichloroethene	9.07E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.07E-02	0.00E+00	0.00E+00
1,2-Dichloroethene (total)	4.79E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.79E-02	0.00E+00	0.00E+00
1,2-Diethylbenzene	3.34E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.34E-02	0.00E+00	0.00E+00
Diethylphthalate	0.00E+00	0.00E+00	1.83E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.83E-04
2,4-Dimethylphenol	2.67E-01	9.09E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.67E-01	9.09E-02	0.00E+00
Di-n-butyl phthalate	2.43E-02	0.00E+00	0.00E+00	3.47E-04	1.74E-05	0.00E+00	0.00E+00	2.47E-02	3.64E-04	3.64E-04
Di-n-octyl phthlate	5.67E-01	0.00E+00	0.00E+00	1.04E-02	7.95E-04	0.00E+00	0.00E+00	5.78E-01	1.12E-02	1.12E-02
Ethylbenzene	2.12E+01	2.93E-02	0.00E+00	3.60E+00	0.00E+00	0.00E+00	0.00E+00	2.50E+01	3.63E+00	3.60E+00
1-ethyl-3-methylbenzene	5.60E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.60E-01	0.00E+00	0.00E+00
Isopropyl benzene (cumene)	8.42E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.42E-02	0.00E+00	0.00E+00
Methylene chloride	1.16E+00	0.00E+00	0.00E+00	1.15E+00	4.57E-06	0.00E+00	0.00E+00	2.31E+00	1.15E+00	1.15E+00
Methyl ethyl ketone	0.00E+00	0.00E+00	0.00E+00	1.10E-03	4.93E-07	0.00E+00	0.00E+00	1.10E-03	1.10E-03	1.10E-03
Naphthalene	4.32E-02	0.00E+00	0.00E+00	0.00E+00	1.31E-03	0.00E+00	0.00E+00	4.45E-02	1.31E-03	1.31E-03
n-Butylbenzene	1.40E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.40E-02	0.00E+00	0.00E+00
n-Decane	9.84E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.84E-01	0.00E+00	0.00E+00
n-Nonane	1.23E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.23E-02	0.00E+00	0.00E+00
Polycyclic aromatic hydrocarbons (PAHs)										
Acenaphthene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.35E-06	0.00E+00	0.00E+00	4.35E-06	4.35E-06	4.35E-06
Acenaphthylene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.93E-06	0.00E+00	0.00E+00	5.93E-06	5.93E-06	5.93E-06
Anthracene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.14E-06	0.00E+00	0.00E+00	3.14E-06	3.14E-06	3.14E-06
Benzo (a) anthracene	0.00E+00	0.00E+00	0.00E+00	2.06E-04	7.74E-05	0.00E+00	0.00E+00	2.84E-04	2.84E-04	2.84E-04
Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	1.45E-04	6.05E-05	0.00E+00	0.00E+00	2.06E-04	2.06E-04	2.06E-04
Benzo(b)fluoranthene/Benzo(k)fluoranthene	0.00E+00	0.00E+00	0.00E+00	2.67E-04	9.92E-05	0.00E+00	0.00E+00	3.66E-04	3.66E-04	3.66E-04
Benzo(g,h,i)perylene	0.00E+00	0.00E+00	0.00E+00	1.35E-04	3.99E-05	0.00E+00	0.00E+00	1.75E-04	1.75E-04	1.75E-04
Chrysene	0.00E+00	0.00E+00	0.00E+00	2.00E-04	7.86E-05	0.00E+00	0.00E+00	2.78E-04	2.78E-04	2.78E-04
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00	0.00E+00	4.79E-05	1.69E-05	0.00E+00	0.00E+00	6.48E-05	6.48E-05	6.48E-05
Fluoranthene	0.00E+00	0.00E+00	0.00E+00	1.67E-04	1.27E-04	0.00E+00	0.00E+00	2.94E-04	2.94E-04	2.94E-04
Fluorene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.87E-06	0.00E+00	0.00E+00	8.87E-06	8.87E-06	8.87E-06
Indeno(1,2,3,c,d) pyrene	0.00E+00	0.00E+00	0.00E+00	1.15E-04	3.02E-05	0.00E+00	0.00E+00	1.45E-04	1.45E-04	1.45E-04
2-Methylnaphthalene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.42E-06	0.00E+00	0.00E+00	2.42E-06	2.42E-06	2.42E-06
Phenanthrene	0.00E+00	0.00E+00	0.00E+00	2.63E-04	1.21E-04	0.00E+00	0.00E+00	3.84E-04	3.84E-04	3.84E-04
Pyrene	0.00E+00	0.00E+00	0.00E+00	2.27E-04	1.57E-04	0.00E+00	0.00E+00	3.84E-04	3.84E-04	3.84E-04

TABLE 5-20. UPPER 95 HAZARD INDEX - CHILD

CHEMICALS	GROUNDWATER SHALLOW	GROUNDWATER INTERMEDIATE	GROUNDWATER DEEP	SOIL	SEDIMENTS	SURFACE WATER	FISH INGESTION	TOTAL USING SHALLOW GROUNDWATER	TOTAL USING INTERMEDIATE GROUNDWATER	TOTAL USING DEEP GROUNDWATER
Phenol	5.41E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.41E-03	0.00E+00	0.00E+00
Tetrachloroethene	2.52E-02	0.00E+00	0.00E+00	8.31E-05	3.26E-06	0.00E+00	0.00E+00	2.53E-02	8.64E-05	8.64E-05
1,2,3,4-Tetramethylbenzene	2.26E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.26E-02	0.00E+00	0.00E+00
Toluene	3.72E-02	0.00E+00	0.00E+00	7.67E-06	2.81E-07	0.00E+00	0.00E+00	3.72E-02	7.95E-06	7.95E-06
1,1,1-Trichloroethane	2.90E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.90E-03	0.00E+00	0.00E+00
Trichloroethene	3.67E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.67E-02	0.00E+00	0.00E+00
1,2,3-Trimethylbenzene/1,2,4-Trimethylbenzene	5.43E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.43E-01	0.00E+00	0.00E+00
1,3,5-Trimethylbenzene	6.53E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.53E-01	0.00E+00	0.00E+00
Xylenes (total)	9.73E+01	2.89E-01	0.00E+00	8.31E-01	2.81E-08	0.00E+00	0.00E+00	9.81E+01	1.12E+00	8.31E-01
INORGANICS										
Aluminum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.27E-01	0.00E+00	0.00E+00	1.27E-01	1.27E-01	1.27E-01
Antimony	8.05E+01	0.00E+00	0.00E+00	0.00E+00	1.08E+00	0.00E+00	0.00E+00	8.16E+01	1.08E+00	1.08E+00
Arsenic	1.19E+00	2.97E-01	0.00E+00	0.00E+00	1.19E-02	1.94E-02	1.54E+00	2.76E+00	1.87E+00	1.57E+00
Barium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.08E-03	1.58E-02	0.00E+00	1.79E-02	1.79E-02	1.79E-02
Beryllium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cadmium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.00E-03	0.00E+00	0.00E+00	5.00E-03	5.00E-03	5.00E-03
Calcium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.90E-04	4.11E-03	0.00E+00	4.30E-03	4.30E-03	4.30E-03
Chromium III	0.00E+00	2.29E-03	7.41E-04	3.77E-03	3.33E-06	5.54E-05	1.60E-03	5.43E-03	7.72E-03	6.17E-03
Chromium VI	0.00E+00	6.53E-02	2.12E-02	1.74E-02	2.38E-04	1.58E-03	5.54E-02	7.46E-02	1.40E-01	9.58E-02
Cobalt	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.29E-03	0.00E+00	0.00E+00	2.29E-03	2.29E-03	2.29E-03
Copper	4.78E-02	1.92E-02	2.05E-02	3.63E-02	1.06E-02	0.00E+00	0.00E+00	9.47E-02	6.61E-02	6.74E-02
Iron	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.65E-02	9.46E-03	0.00E+00	7.60E-02	7.60E-02	7.60E-02
Lead	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Magnesium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.58E-04	3.36E-03	0.00E+00	3.61E-03	3.61E-03	3.61E-03
Manganese	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.70E-04	7.11E-04	0.00E+00	1.38E-03	1.38E-03	1.38E-03
Mercury	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.33E-03	0.00E+00	0.00E+00	8.33E-03	8.33E-03	8.33E-03
Nickel	2.33E-01	3.40E+00	0.00E+00	2.50E-02	9.45E-04	0.00E+00	0.00E+00	2.59E-01	3.43E+00	2.59E-02
Potassium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.44E-05	0.00E+00	0.00E+00	3.44E-05	3.44E-05	3.44E-05
Selenium	8.75E-02	5.56E-02	0.00E+00	0.00E+00	0.00E+00	6.60E-03	2.40E-02	1.16E-01	8.62E-02	3.06E-02
Sodium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.98E-06	7.09E-04	0.00E+00	7.12E-04	7.12E-04	7.12E-04
Thallium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Vanadium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.80E-02	2.83E-02	0.00E+00	4.63E-02	4.63E-02	4.63E-02
Zinc	6.97E-02	7.62E-02	1.17E-01	2.03E-02	2.74E-03	0.00E+00	0.00E+00	9.27E-02	9.92E-02	1.40E-01
Cyanide	0.00E+00	0.00E+00	0.00E+00	2.74E-02	0.00E+00	0.00E+00	0.00E+00	2.74E-02	2.74E-02	2.74E-02
TOTAL PATHWAY RISK	4.13E+02	4.43E+00	6.19E+00	1.15E+02	1.36E+00	9.01E-02	1.62E+00	5.31E+02	1.22E+02	1.24E+02
PERCENT TOTAL RISK (SHALLOW GROUNDWATER USE)	77.81	0.84	1.17	21.61	0.26	0.02	0.31	100.00		
PERCENT TOTAL RISK (INTERMEDIATE GROUNDWATER USE)	337.96	3.63	5.06	93.86	1.12	0.07	1.33		100.00	
PERCENT TOTAL RISK (DEEP GROUNDWATER USE)	333.18	3.58	4.99	92.53	1.10	0.07	1.31			100.00

TABLE 5-21. COMPARATIVE POTENCY APPROACH - AVERAGE CARCINOGENIC RISK - WORKER

	SOIL PATHWAY			WORKER TOTAL RISK
CHEMICALS	INGESTION	INHALATION	DERMAL	TOTAL
ORGANICS				
Aroclor 1254	5.65E-07	6.79E-09	5.12E-06	5.69E-06
Benzene	1.74E-10	2.09E-12	8.76E-09	8.93E-09
Bis(2-ethylhexyl) phthalate	3.37E-07	4.05E-09	3.05E-06	3.39E-06
Methylene chloride	2.06E-10	4.61E-12	1.03E-08	1.06E-08
Polycyclic aromatic hydrocarbons (PAHs)				
Benzo (a) anthracene	1.96E-07	1.25E-09	7.09E-07	9.06E-07
	3.34E-08	5.64E-11	1.21E-07	1.54E-07
Benzo(a)pyrene	1.74E-07	1.11E-09	6.29E-07	8.03E-07
	8.16E-08	1.38E-10	2.96E-07	3.77E-07
Benzo(b)fluoranthene/Benzo(k)fluoranthene	2.59E-07	1.65E-09	9.39E-07	1.20E-06
	1.87E-08	3.17E-11	6.78E-08	8.66E-08
Benzo(g,h,i)perylene	9.93E-10	1.68E-12	3.59E-09	4.59E-09
Chrysene	1.93E-07	1.23E-09	6.99E-07	8.93E-07
	4.68E-10	7.87E-13	1.69E-09	2.16E-09
Dibenzo(a,h)anthracene	8.80E-08	5.60E-10	3.18E-07	4.07E-07
	3.32E-08	5.61E-11	1.20E-07	1.53E-07
Indeno(1,2,3,c,d) pyrene	1.56E-07	9.93E-10	5.65E-07	7.22E-07
	1.42E-08	2.40E-11	5.14E-08	6.56E-08
Pyrene	4.79E-09	8.11E-12	1.73E-08	2.21E-08
Tetrachloroethene	2.98E-11	2.31E-14	1.50E-09	1.53E-09
INORGANICS				
Chromium VI		2.22E-07		2.22E-07
Nickel		2.31E-08		2.31E-08
TOTAL USING TEF APPROACH FOR PAHs	1.09E-06	2.56E-07	6.87E-06	1.02E-05
TOTAL	1.97E-06	2.62E-07	1.21E-05	1.43E-05

TABLE 5-22. COMPARATIVE POTENCY APPROACH - UPPER 95 CARCINOGENIC RISK - WORKER

	SOIL PATHWAY			WORKER TOTAL RISK
CHEMICALS	INGESTION	INHALATION	DERMAL	TOTAL
ORGANICS				
Aroclor 1254	4.42E-06	5.30E-08	4.00E-05	4.45E-05
Benzene	1.74E-07	2.09E-09	8.76E-06	8.94E-06
Bis(2-ethylhexyl) phthalate	7.36E-05	6.83E-07	6.66E-04	7.40E-04
Methylene chloride	4.07E-07	9.12E-09	2.05E-05	2.09E-05
Polycyclic aromatic hydrocarbons (PAHs)				
Benzo (a) anthracene	4.37E-07	2.78E-09	1.58E-06	2.02E-06
	1.77E-08	2.99E-11	6.41E-08	8.19E-08
Benzo(a)pyrene	3.08E-07	1.96E-09	1.12E-06	1.43E-06
	8.65E-08	1.46E-10	3.13E-07	3.99E-07
Benzo(b)fluoranthene/Benzo(k)fluoranthene	5.66E-07	3.60E-09	2.05E-06	2.62E-06
	2.21E-08	3.74E-11	8.01E-08	1.02E-07
Benzo(g,h,i)perylene	1.76E-09	2.98E-12	6.38E-09	8.14E-09
Chrysene	4.23E-07	2.69E-09	1.53E-06	1.96E-06
	5.22E-10	8.77E-13	1.89E-09	2.41E-09
Dibenzo(a,h)anthracene	1.02E-07	6.46E-10	3.68E-07	4.70E-07
	3.15E-08	5.33E-11	1.14E-07	1.46E-07
Indeno(1,2,3,c,d) pyrene	2.44E-07	1.55E-09	8.82E-07	1.13E-06
	1.59E-08	2.68E-11	5.74E-08	7.33E-08
Pyrene	1.09E-08	1.84E-11	3.94E-08	5.03E-08
Tetrachloroethene	3.32E-11	2.58E-14	1.67E-09	1.70E-09
INORGANICS				
Chromium VI		4.08E-07		4.08E-07
Nickel		3.78E-08		3.78E-08
TOTAL USING TEF APPROACH FOR PAHs	7.88E-05	1.39E-06	7.36E-04	8.16E-04
TOTAL	8.07E-05	1.41E-06	7.43E-04	8.25E-04

TABLE 5-23. COMPARATIVE POTENCY APPROACH - AVERAGE CARCINOGENIC RISK - TRESPASSER

CHEMICAL	SOIL PATHWAY			TRESPASSER TOTAL RISK
	INGESTION	INHALATION	DERMAL	ALL PATHWAYS
ORGANICS				
Aroclor 1254	1.77E-08	1.77E-11	1.60E-07	1.78E-07
Benzene	5.45E-12	5.45E-15	2.74E-10	2.76E-10
Bis(2-ethylhexyl) phthalate	1.05E-08	1.05E-11	9.53E-09	1.06E-07
Methylene chloride	6.43E-12	1.20E-14	3.23E-10	3.30E-10
Polycyclic aromatic hydrocarbons (PAHs)				
Benzo (a) anthracene	6.12E-09	3.25E-12	2.22E-08	2.83E-08
	1.04E-09	1.47E-13	3.78E-09	4.82E-09
Benzo(a)pyrene	5.43E-09	2.88E-12	1.96E-08	2.51E-08
	2.55E-09	3.59E-13	9.23E-09	1.18E-08
Benzo(b)fluoranthene/Benzo(k)fluoranthene	8.11E-09	4.30E-12	2.93E-08	3.74E-08
	5.86E-10	8.25E-14	2.12E-09	2.71E-09
Benzo(g,h,i)perylene	3.10E-11	4.37E-15	1.12E-10	1.43E-10
Chrysene	6.03E-09	3.20E-12	2.18E-08	2.79E-08
	1.46E-11	2.05E-15	5.29E-11	6.75E-11
Dibenzo(a,h)anthracene	2.75E-09	1.46E-12	9.95E-09	1.27E-08
	1.04E-09	1.46E-13	3.75E-09	4.79E-09
Indeno(1,2,3,c,d) pyrene	4.88E-09	2.59E-12	1.76E-08	2.25E-08
	4.44E-10	6.24E-14	1.61E-09	2.05E-09
Pyrene	1.50E-10	2.11E-14	5.42E-10	6.91E-10
Tetrachloroethene	9.30E-13	6.02E-17	4.67E-11	4.77E-11
INORGANICS				
Chromium VI	0.00E+00	5.77E-10	0.00E+00	5.77E-10
Nickel	0.00E+00	6.00E-11	0.00E+00	6.00E-11
ROUTE TOTAL RISK (COMPARATIVE POTENCY APPROACH)	9.39E-08	6.66E-10	2.76E-07	6.11E-07
ROUTE TOTAL RISK (EPA APPROACH)	6.17E-08	6.83E-10	3.77E-07	4.40E-07

COMPARATIVE POTENCY APPROACH NUMBERS

TABLE 5-24. COMPARATIVE POTENCY APPROACH - UPPER 95 CARCINOGENIC RISK - TRESPASSER

CHEMICAL	SOIL PATHWAY			TRESPASSER TOTAL RISK
	INGESTION	INHALATION	DERMAL	ALL PATHWAYS
ORGANICS				
Aroclor 1254	1.38E-07	1.38E-10	1.25E-06	1.39E-06
Benzene	5.45E-09	5.45E-12	2.74E-07	2.79E-07
Bis(2-ethylhexyl) phthalate	2.30E-06	2.30E-09	2.08E-05	2.31E-05
Methylene chloride	1.27E-08	2.38E-11	6.40E-07	6.53E-07
Polycyclic aromatic hydrocarbons (PAHs)				
Benzo (a) anthracene	1.37E-08	7.25E-12	4.96E-08	6.31E-08
	5.54E-10	7.76E-14	2.00E-09	2.56E-09
Benzo(a)pyrene	9.64E-09	5.11E-12	3.49E-08	4.45E-08
	2.70E-09	3.80E-13	9.78E-09	1.25E-08
Benzo(b)fluoranthene/Benzo(k)fluoranthene	1.77E-08	9.39E-12	6.40E-08	8.18E-08
	6.92E-10	9.75E-14	2.50E-09	3.20E-09
Benzo(g,h,i)perylene	5.51E-11	7.75E-15	1.99E-10	2.54E-10
Chrysene	1.32E-08	7.02E-12	4.79E-08	6.11E-08
	1.63E-11	2.29E-15	6.90E-11	7.53E-11
Dibenzo(a,h)anthracene	3.17E-09	1.68E-12	1.16E-08	1.47E-08
	9.85E-10	1.39E-13	3.57E-09	4.56E-09
Indeno(1,2,3,c,d) pyrene	7.62E-09	4.04E-12	2.76E-08	3.52E-08
	4.96E-10	6.97E-14	1.79E-09	2.29E-09
Pyrene	3.40E-10	4.80E-14	1.23E-09	1.57E-09
Tetrachloroethane	1.04E-12	6.72E-17	5.22E-11	5.33E-11
INORGANICS				
Chromium VI	0.00E+00	1.06E-09	0.00E+00	1.06E-09
Nickel	0.00E+00	9.84E-11	0.00E+00	9.84E-11
ROUTE TOTAL RISK (COMPARATIVE POTENCY APPROACH)	2.46E-06	3.83E-09	2.30E-05	2.56E-05
ROUTE TOTAL RISK (EPA APPROACH)	2.52E-06	3.66E-09	2.32E-05	2.57E-05

TABLE 5-25 COMPARATIVE POTENCY APPROACH - AVERAGE CARCINOGENIC RISK - WADER/SWIMMER

CHEMICAL	SEDIMENTS PATHWAY			SURFACE WATER PATHWAY			WADER/SWIMMER TOTAL RISK
	INGESTION	DERMAL	PATHWAY TOTAL	INGESTION	DERMAL	PATHWAY TOTAL	ALL PATHWAYS
ORGANICS							
Bis(2-ethylhexyl) phthalate	5.38E-10	3.53E-09	4.07E-09				4.07E-09
Methylene chloride	2.71E-12	9.86E-12	1.26E-11				1.26E-11
Polycyclic aromatic hydrocarbons (PAHs)							
Benzo (a) anthracene	6.40E-08	1.68E-07	2.32E-07				2.32E-07
	2.60E-09	6.83E-09	9.43E-09				9.43E-09
Benzo(a)pyrene	5.75E-08	1.51E-07	2.09E-07				2.09E-07
	1.61E-08	4.23E-08	5.84E-08				5.84E-08
Benzo(b)fluoranthene/Benzo(k)fluoranthene	8.54E-08	2.24E-07	3.10E-07				3.10E-07
	3.34E-09	8.78E-09	1.21E-08				1.21E-08
Benzo(g,h,i)perylene	2.93E-10	7.70E-10	1.06E-09				1.06E-09
Chrysene	7.01E-08	1.84E-07	2.54E-07				2.54E-07
	8.65E-11	2.27E-10	3.14E-10				3.14E-10
Dibenzo(a,h)anthracene	2.38E-08	6.25E-08	8.63E-08				8.63E-08
	7.38E-09	1.94E-08	2.68E-08				2.68E-08
Indeno(1,2,3,c,d) pyrene	3.62E-08	1.00E-07	1.39E-07				1.39E-07
	2.48E-09	6.52E-09	9.00E-09				9.00E-09
Pyrene	2.07E-09	5.43E-09	7.50E-09				7.50E-09
Tetrachloroethene	1.11E-12	4.05E-11	4.16E-11				4.16E-11
INORGANICS							
Arsenic	8.48E-08	0.00E+00	8.48E-08	5.18E-08	1.53E-07	2.05E-07	2.90E-07
ROUTE TOTAL RISK (COMPARATIVE POTENCY APPROACH)	1.17E-07	8.78E-08	2.05E-07	5.18E-08	1.53E-07	2.05E-07	4.10E-07
ROUTE TOTAL RISK (EPA APPROACH)	4.27E-07	9.00E-07	1.33E-06	5.18E-08	1.53E-07	2.05E-07	1.53E-06

COMPARATIVE POTENCY APPROACH NUMBERS

TABLE 5-26 COMPARATIVE POTENCY APPROACH - UPPER 95 CARCINOGENIC RISK - WADER/SWIMMER

CHEMICAL	SEDIMENTS PATHWAY			SURFACE WATER PATHWAY			WADER/SWIMMER TOTAL RISK
	INGESTION	DERMAL	PATHWAY TOTAL	INGESTION	DERMAL	PATHWAY TOTAL	ALL PATHWAYS
ORGANICS							
Bis(2-ethylhexyl) phthalate	6.51E-09	4.28E-08	4.93E-08				4.93E-08
Methylene chloride	2.71E-12	9.89E-12	1.26E-11				1.26E-11
Polycyclic aromatic hydrocarbons (PAHs)							
Benzo (a) anthracene	4.51E-07	1.18E-06	1.63E-06				1.63E-06
	1.83E-08	4.81E-08	6.64E-08				6.64E-08
Benzo(a)pyrene	3.52E-07	9.25E-07	1.28E-06				1.28E-06
	9.86E-08	2.59E-07	3.58E-07				3.58E-07
Benzo(b)fluoranthene/Benzo(k)fluoranthene	5.77E-07	1.52E-06	2.09E-06				2.09E-06
	2.26E-08	5.94E-08	8.20E-08				8.20E-08
Benzo(g,h,i)perylene	1.43E-09	3.76E-09	5.19E-09				5.19E-09
Chrysene	4.58E-07	1.20E-06	1.66E-06				1.66E-06
	5.65E-10	1.49E-09	2.05E-09				2.05E-09
Dibenzo(a,h)anthracene	9.86E-08	2.59E-07	3.58E-07				3.58E-07
	3.06E-08	8.04E-08	1.11E-07				1.11E-07
Indeno(1,2,3,c,d) pyrene	1.76E-07	4.63E-07	6.39E-07				6.39E-07
	1.14E-08	3.00E-08	4.15E-08				4.15E-08
Pyrene	2.07E-08	5.44E-08	7.51E-08				7.51E-08
Tetrachloroethene	2.73E-12	9.97E-11	1.02E-10				1.02E-10
INORGANICS							
Arsenic	1.28E-07	0.00E+00	1.28E-07	5.25E-08	1.55E-07	2.07E-07	3.36E-07
ROUTE TOTAL RISK (COMPARATIVE POTENCY APPROACH)	9.17E-07	5.21E-07	8.38E-07	5.25E-08	1.55E-07	2.07E-07	1.05E-06
ROUTE TOTAL RISK (EPA APPROACH)	2.27E-06	5.66E-06	7.92E-06	5.25E-08	1.55E-07	2.07E-07	8.13E-06

COMPARATIVE POTENCY APPROACH NUMBERS

TABLE 5-27. COMPARATIVE POTENCY APPROACH - AVERAGE LIFETIME CARCINOGENIC RISK (SUM OF ADULT AND CHILD RESIDENT) - ALL PATHWAYS, FUTURE USE ONLY

CHEMICAL	GROUNDWATER SHALLOW	GROUNDWATER INTERMEDIATE	GROUNDWATER DEEP	SOIL	SEDIMENTS	SURFACE WATER	FISH INGESTION	TOTAL USING SHALLOW GROUNDWATER	TOTAL USING INTERMEDIATE GROUNDWATER	TOTAL USING DEEP GROUNDWATER
ORGANICS										
Aroclor 1254				2.29E-05				2.29E-05	2.29E-05	2.29E-05
Benzene				3.18E-08				3.18E-08	3.18E-08	3.18E-08
Bis(2-ethylhexyl) phthalate	3.41E-05	1.20E-06	3.13E-06	1.37E-05	4.07E-09			4.78E-05	1.49E-05	1.68E-05
1,1-Dichloroethane	1.69E-05							1.69E-05		
1,2-Dichloroethane			4.18E-06							4.18E-06
1,1-Dichloroethene	8.99E-05							8.99E-05		
Methylene chloride	9.49E-06			3.75E-08	1.26E-11			9.53E-06	3.75E-08	3.75E-08
Polyaromatic hydrocarbons (PAHs)										
Benzo (a) anthracene				4.27E-06	2.32E-07			4.50E-06	4.50E-06	4.50E-06
				4.80E-07	9.43E-09			4.89E-07	4.89E-07	4.89E-07
Benzo(a)pyrene				3.79E-06	2.09E-07			3.99E-06	3.99E-06	3.99E-06
				1.17E-06	5.84E-08			1.23E-06	1.23E-06	1.23E-06
Benzo(b)fluoranthene/Benzo(k)fluoranthene				5.65E-06	3.10E-07			5.96E-06	5.96E-06	5.96E-06
				2.70E-07	1.21E-08			2.82E-07	2.82E-07	2.82E-07
Benzo(g,h,i)perylene				2.16E-08	1.06E-09			2.27E-08	2.27E-08	2.27E-08
Chrysene				4.21E-06	2.54E-07			4.46E-06	4.46E-06	4.46E-06
				6.73E-09	3.14E-10			7.04E-09	7.04E-09	7.04E-09
Dibenzo(a,h)anthracene				1.92E-06	8.63E-08			2.00E-06	2.00E-06	2.00E-06
				4.77E-07	2.68E-08			5.04E-07	5.04E-07	5.04E-07
Indeno(1,2,3,c,d) pyrene				3.40E-06	1.39E-07			3.54E-06	3.54E-06	3.54E-06
				2.04E-07	9.00E-09			2.13E-07	2.13E-07	2.13E-07
Pyrene				1.04E-07	7.50E-09			1.12E-07	1.12E-07	1.12E-07
Tetrachloroethene	2.62E-06			5.42E-09	4.16E-11			2.63E-06	5.47E-09	5.47E-09
Trichloroethene	1.42E-06							1.42E-06		
INORGANICS										
Arsenic	1.92E-04	1.09E-04			8.48E-08	2.05E-07	6.19E-04	8.11E-04	7.28E-04	6.19E-04
Beryllium										
Cadmium										
Chromium VI				7.72E-07				7.72E-07	7.72E-07	7.72E-07
Nickel				8.03E-08				8.03E-08	8.03E-08	8.03E-08
ROUTE TOTAL RISK (COMPARATIVE POTENCY APPROACH)	3.46E-04	1.10E-04	7.31E-06	4.01E-05	2.05E-07	2.05E-07	6.19E-04	1.01E-03	7.70E-04	6.87E-04
ROUTE TOTAL RISK (EPA APPROACH)	3.46E-04	1.10E-04	7.31E-06	6.08E-05	1.33E-06	2.05E-07	6.19E-04	1.03E-03	7.92E-04	6.89E-04

COMPARATIVE POTENCY APPROACH NUMBERS

28-May-91 L.E. CARPENTER

TABLE 5-28. COMPARATIVE POTENCY APPROACH - UPPER 95 LIFETIME CARCINOGENIC RISK (SUM OF ADULT AND CHILD RESIDENT) - ALL PATHWAYS, FUTURE USE ONLY

CHEMICAL	GROUNDWATER SHALLOW	GROUNDWATER INTERMEDIATE	GROUNDWATER DEEP	SOIL	SEDIMENTS	SURFACE WATER	FISH INGESTION	TOTAL USING SHALLOW GROUNDWATER	TOTAL USING INTERMEDIATE GROUNDWATER	TOTAL USING DEEP GROUNDWATER
ORGANICS										
Aroclor 1254				1.79E-04				1.79E-04	1.79E-04	1.79E-04
Benzene				3.18E-05				3.18E-05	3.18E-05	3.18E-05
Bis(2-ethylhexyl) phthalate	1.35E-02	7.01E-06	3.91E-04	2.98E-03	4.93E-08			1.65E-02	2.99E-03	3.37E-03
1,1-Dichloroethane	2.94E-04							2.94E-04		
1,2-Dichloroethane			4.80E-06							4.80E-06
1,1-Dichloroethene	1.07E-04							1.07E-04		
Methylene chloride	3.24E-04			7.43E-05	1.26E-11			3.98E-04	7.43E-05	7.43E-05
Polyaromatic hydrocarbons (PAHs)										
Benzo (a) anthracene				9.53E-06	1.83E-06			1.12E-05	1.12E-05	1.12E-05
				2.55E-07	6.64E-08			3.21E-07	3.21E-07	3.21E-07
Benzo(a)pyrene				6.72E-06	1.28E-06			8.00E-06	8.00E-06	8.00E-06
				1.24E-06	3.58E-07			1.60E-06	1.60E-06	1.60E-06
Benzo(b)fluoranthene/Benzo(k)fluoranthene				1.23E-05	2.09E-06			1.44E-05	1.44E-05	1.44E-05
				3.18E-07	8.20E-08			4.00E-07	4.00E-07	4.00E-07
Benzo(g,h,i)perylene				3.84E-08	5.19E-09			4.36E-08	4.36E-08	4.36E-08
Chrysene				9.22E-06	1.66E-06			1.09E-05	1.09E-05	1.09E-05
				7.60E-09	2.05E-09			9.65E-09	9.65E-09	9.65E-09
Dibenzo(a,h)anthracene				2.21E-06	3.58E-07			2.57E-06	2.57E-06	2.57E-06
				4.53E-07	1.11E-07			5.64E-07	5.64E-07	5.64E-07
Indeno(1,2,3,c,d) pyrene				5.31E-06	6.30E-07			5.95E-06	5.95E-06	5.95E-06
				2.28E-07	4.15E-08			2.70E-07	2.70E-07	2.70E-07
Pyrene				2.37E-07	7.51E-08			3.12E-07	3.12E-07	3.12E-07
Tetrachloroethene	3.00E-06			6.06E-09	1.02E-10			3.01E-06	6.16E-09	6.16E-09
Trichloroethene	1.71E-06							1.71E-06		
INORGANICS										
Arsenic	4.84E-04	1.91E-04			1.28E-07	2.08E-07	6.29E-04	1.11E-03	7.60E-04	8.29E-04
Beryllium										
Cadmium										
Chromium VI				1.42E-06				1.42E-06	1.42E-06	1.42E-06
Nickel				1.32E-07				1.32E-07	1.32E-07	1.32E-07
ROUTE TOTAL RISK (COMPARATIVE POTENCY APPROACH)	1.47E-02	1.28E-04	3.96E-04	3.27E-03	8.38E-07	2.08E-07	6.29E-04	1.88E-02	4.08E-03	4.80E-03
ROUTE TOTAL RISK (EPA APPROACH)	1.47E-02	1.28E-04	3.96E-04	3.31E-03	7.92E-06	2.08E-07	6.29E-04	1.87E-02	4.08E-03	4.35E-03

COMPARATIVE POTENCY APPROACH NUMBERS

Table 5-29
Substances in Media Sampled That Exceed* Minimum Risk Levels Using Upper 95% Confidence Limit Concentrations

Substance	Medium	Receptor Type	Type of Health Effects
Bis(2-ethylhexyl) phthalate	Soil	Worker, trespasser, resident	Cancer, noncancer
Aroclor 1254	Soil	Worker, trespasser, resident	Cancer, noncancer
Methylene chloride	Soil	Worker, resident	Cancer
Benzene	Soil	Worker, resident	Cancer, noncancer
PAHs	Soil	Worker, resident	Cancer
Chromium (hexavalent)	Soil	Resident	Cancer
Bis(2-ethylhexyl phthalate	Sediments	Wader/swimmer	Cancer
PAHs	Sediments	Wader/swimmer	Cancer
Arsenic	Sediments	Wader/swimmer	Cancer
Antimony	Sediments	Wader/swimmer	Noncancer
Arsenic	Surface water	Fish ingestion	Cancer, noncancer
Bis(2-ethylhexyl) phthalate	Groundwater - shallow, int, deep	Resident	Cancer, noncancer
Di-n-octylphthalate	Groundwater - shallow	Resident	Noncancer
1,1-Dichloroethane**	Groundwater - shallow	Resident	Cancer
Methylene chloride	Groundwater - shallow	Resident	Cancer, noncancer
1,1-Dichloroethene**	Groundwater - shallow	Resident	Cancer
Tetrachloroethene**	Groundwater - shallow	Resident	Cancer
1,2-Dichloroethane	Groundwater - deep	Resident	Cancer
Trichloroethene**	Groundwater - shallow	Resident	Cancer
Ethylbenzene	Groundwater - shallow	Resident	Noncancer
Xylenes	Groundwater - shallow	Resident	Noncancer
Arsenic	Groundwater - shallow, int.	Resident	Cancer, noncancer
Antimony	Groundwater - shallow	Resident	Noncancer
Nickel	Groundwater, Int.	Resident	Noncancer

* Minimum risk is defined as exceeding either alone or in combination with other substances, a 1E-06 cancer risk potential or an HI of 1.
**Appear only in offsite well MW-13s; relevance to the site is uncertain.

- Worker exposure to soil contaminated with Aroclor 1254, methylene chloride and bis(2-ethylhexyl)phthalate.

- Trespasser exposure to soil contaminated with bis(2-ethylhexyl)phthalate.

- Hypothetical on-site residents exposed to soil contaminated with Aroclor 1254, benzene, bis(2-ethylhexyl)phthalate, methylene chloride, and carcinogenic polynuclear aromatic hydrocarbons (PAH).

- Hypothetical on-site residents using groundwater beneath the site as their water supply for potable and non-potable uses. In shallow groundwater, the substances include antimony, arsenic, bis(2-ethylhexyl) phthalate, ethylbenzene, methylene chloride and total xylenes. Offsite well MW-13s contained levels of 1,1-dichloroethane and 1,1-dichloroethene above this potential risk level. In the intermediate zone, only arsenic presents a calculated risk potential above the criteria. In deep groundwater, only bis(2-ethylhexyl) phthalate exceeded the criteria.

- Recreational fisherman consuming fish containing arsenic from the Rockaway River in the vicinity of the L.E. Carpenter site.

Finally, substances in the various media sampled that present risk potential greater than one excess case of cancer per ten-thousand persons or a hazard index of 100 using upper 95% confidence limit concentrations included:

- Worker exposed to soil containing Aroclor 1254, and bis(2-ethylhexyl) phthalate.

- Hypothetical onsite residents exposed to soil containing Aroclor 1254 and bis(2-ethylhexyl) phthalate.

- Recreational fisherman consuming arsenic in fish from the Rockaway River in the vicinity of the L.E. Carpenter site.

- Hypothetical onsite residents using groundwater beneath the site as their water supply for potable and non-potable uses. In shallow groundwater the substances include bis(2-ethylhexyl) phthalate, methylene chloride and arsenic. Offsite well MW-13s contained levels of 1,1-dichloroethane and 1,1-dichloroethene above this potential risk

level. In the intermediate zone, arsenic exceeded the criteria and in the deep zone, bis(2-ethylhexyl) phthalate exceeded the criteria.

Remedial actions, as well as risk management decisions are guided in part by the results of the human health risk assessment. Moreover, an evaluation of alternatives for the comprehensive remedial plan for the site will also need to consider ARARs, other guidance and standards as well as interim guidances to determine appropriate media specific clean-up goals and action levels.

5.7 REFERENCES

Clement (ICF-Clement Associates), 1988. *Comparative Potency Approach for Estimating the Cancer Risk Associated with Exposure to Mixtures of Polycyclic Aromatic Hydrocarbons.* Interim Final Report. ICF Clement Associates, Fairfax, Virginia.

EPA (U.S. Environmental Protection Agency), 1985. *Development of Statistical Distributions or Ranges of Standard Factors Used in Exposure Assessments.* U.S. EPA, Washington, D.C. 1985.

EPA (U.S. Environmental Protection Agency) 1989a. *Supplemental Risk Assessment Guidance for the Superfund Program.* Draft Final. Prepared by the U.S. EPA Region I Risk Assessment Work Group. June, 1989.

EPA (U.S. Environmental Protection Agency), 1989b. Memorandum Concerning Lead Concentration in Soil. OSWER Directive 9355.4-02.

EPA (U.S. Environmental Protection Agency), 1990. Memorandum from Henry Longest, Director OERR and Bruce Diamond, Director OWPE, titled *Cleanup Level for Lead in Groundwater.* Date of Memorandum, June 21, 1990.

SECTION 6
ECOLOGICAL RISK ASSESSMENT

6.1 PURPOSE AND APPROACH

The purpose of this ecological assessment is to identify and estimate the potential ecological impacts associated with the release of contaminants from the L.E. Carpenter facility in Wharton, New Jersey. This study focuses on identifying potential adverse effects from the release of contaminants on the aquatic natural resources in the Rockaway River, which is adjacent to the site.

The technical guidance for the performance of this risk assessment comes from several sources, including the *Endangerment Assessment Handbook* (EPA, 1986); *Ecological Risk Assessment* (Urban and Cook, 1986); and the *Interim Final Risk Assessment Guidance for Superfund: Volume II Environmental Evaluation Manual* (EPA, 1989). Additional guidance on the scope of this ecological assessment was provided in correspondence from NJDEP to M.A. Hanna Company, dated 28 August 1990 (Kaup, 1990). Numerous other information sources were used to assist in report preparation and have been included in the references to this section.

The process used to evaluate ecological risk approximately parallels that for evaluating human health risk. In both cases, the integration of information on chemical exposures with toxicity data for the pollutants of concern is used to estimate the potential risk from that exposure. Consequently, the principal tasks for ecological assessment include the following:

- Selecting contaminants of concern.
- Analyzing environmental receptors/pathways.
- Estimating exposure point concentrations and exposure doses (if required).
- Identifying environmental toxicity.
- Characterizing ecological risk.

6.2 SELECTION OF CONTAMINANTS OF CONCERN

Contaminants of concern for the ecological assessment were selected in a manner similar to that used in the human health assessment.

For the purpose of the ecological assessment it was determined that the aquatic resources of the Rockaway River were the major ecological concern at this location. Therefore, surface water and sediment samples collected in the Rockaway River were considered for further evaluation. The average contaminant concentrations for both surface waters and sediments were compared with background concentrations taken from upgradient location(s). Background sediment samples were taken at three locations in the Rockaway River: in Washington Forge Pond, between the Washington Forge Pond spillway and the railroad right-of-way, and just east of the right-of-way (see Figure 1-2). The surface water background sample was taken in Washington Forge Pond. Due to limited sample sizes, only the geometric means for all identified inorganics was compared. If the background concentration exceeded the mean site concentration, and if there were no reason to assume site-related anthropogenic sources, then the contaminant was eliminated from additional consideration. Because the majority of organic chemicals found at Superfund sites are not naturally occurring, all organics identified in the Rockaway River samples were considered in the subsequent ecological evaluation (EPA, 1989), even if they were present in the upgradient samples.

The resulting lists of the contaminants of concern, by media, are provided in Tables 6-1 and 6-2.

6.3 ECOLOGICAL SETTING

As discussed in previous sections, the L.E. Carpenter facility is located in the Borough of Wharton, Morris County, New Jersey. The property occupies 14.6 acres, approximately 3.5 acres of which are covered by vegetation, the remaining acreage consists primarily of

Table 6-1

Contaminants of Concern for the Ecological Assessments (Surface Water)

Arsenic
Barium
Calcium
Chromium
Iron
Magnesium
Manganese
Selenium
Sodium
Vanadium

Table 6-2

Contaminants of Concern for the Ecological Assessment (Sediments)

ORGANICS (μg/kg)

Bis(2-ethylhexyl)phthalate
Butyl benzyl phthalate
Di-n-butyl phthalate
Di-n-octyl phthalate
Methyl ethyl ketone
Methylene chloride
Polycyclic aromatic hydrocarbons (PAHs)
- Acenaphthene
- Acenaphthylene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene/benzo(k)fluoranthene
- Benzo(g,h,i)perylene
- Chrysene
- Dibenzo(a,h)anthracene
- Fluoranthene
- Fluorene
- Indeno(1,2,3,c,d)pyrene
- 2-Methylnapthalene
- Naphthalene
- Phenanthrene
- Pyrene

Tetrachloroethene
Toluene
Xylenes (total)

INORGANICS (mg/kg)

Aluminum
Antimony
Arsenic
Barium
Cadmium
Calcium
Chromium

Table 6-2
(continued)

Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Potassium
Sodium
Vanadium
Zinc

buildings, roads, parking lots, railroad right-of-way, and miscellaneous manufacturing related facilities (e.g., tank farm). The site is bordered to south by the Rockaway River; to the east by a drainage ditch located on Air Products and Chemical, Inc., property, and Wharton Enterprises, Inc.; and to the north and west by the urban build-up residential area of Wharton, New Jersey.

A site visit to the L.E. Carpenter facility was performed by two WESTON ecologists on 17 May 1990. During the site visit both the terrestrial and aquatic settings were evaluated for future characterization and for identification of observable adverse effects related to site contamination.

The majority of the vegetation on-site is early successional herbaceous cover with relatively narrow wooded strips located along the banks of Rockaway River and adjacent to the abandoned railroad right-of-way that bisects the site. The dominant floral composition on-site consisted primarily of "invader species" that are characteristic of a highly disturbed area, (i.e., common mullein (*Verbascum thapsus*), plantain (*Plantago sp.*), brome grass (*Bromus sp.*), chickory (*Chichorium intybus*), ragweed (*Ambrosia sp.*), orchard grass (*Dactylis glomenta*), multiflora rose (*Rose multiflora*), poison sumac (*Rhus typhina*), red maple (*Acer rubrum*), basswood (*Tilia americana*), and aspen (*Populus tremuloides*). No contaminant-related phytotoxic effects were observed on any terrestrial or aquatic flora during the site visit.

The limited terrestrial fauna observed on-site is characteristic of a highly urbanized environment and consisted of species normally encountered in an urban setting.

Species that were observed during the site visit included: house sparrow (*Passer domesticus*), blue jay (*Cyanocitta cristata*), rock dove (*Columba laivia*), mourning dove (*Zenaidura macroura*), starling (*Sturnus vulgaris*), common crow (*Corvus caurinus*), eastern chipmunk (*Tamais striatus*), and cottontail rabbit (*Sylvilagus floridanus*).

There did not appear to be any unique or sensitive terrestrial habitats that would support any sensitive species of concern for this assessment.

The prominent aquatic feature at the L.E. Carpenter facility is the Rockaway River, which bounds the site to south. The Rockaway River is currently classified as an FW2-TM (fresh water trout maintenance) surface water and, as such, is regulated to maintain surface water quality that is suitable for year-round support of trout populations. The stretch of river adjacent to the site is approximately 10 to 20 meters wide with depths ranging from .25 to 1.5 meters.

The substrate is primarily rocky with a medium to very fine-grained layer of sediment. The river is stocked annually by the NJDEP Division of Fish, Game and Wildlife with rainbow, brown and brook trout. It also provides good habitat for white sucker (*Catostomus commersoni*), creek chub (*Semotilus atromaculatus*), fallfish (*S. corporalis*), spotfin shiner (*Notropis hudsonius*) and American eel (*Anguila rostrata*).

A request for a database search for any records of rare or endangered plants, animals, and natural communities has been submitted to the New Jersey Natural Heritage Program. The results of this search have not been received, but will be provided to EPA and NJDEP in the form of a memorandum as an appendium to the ecological risk assessment.

6.4 EXPOSURE ASSESSMENT

The goals of the exposure assessment are to answer the following questions:

- What biological resources are exposed to site related contaminants?
- What are the significant pathways/routes of exposure?
- What is the magnitude, duration and frequency of exposure?

Consequently, the first step of any exposure assessment is to identify both the pathways of specific concern and the sensitive habitats, communities and/or target species within each of these pathways.

The following discusses the factors considered during the pathway selection for the L.E. Carpenter Site. It eliminates those pathways and exposure routes that are not of concern, based on the analysis of site characteristics, and provides a focus for those pathways critical to the ecological assessment.

Factors that have gone into the pathway selection process include:

- Contaminant source locations (i.e., storage tank locations, on-site disposal areas, and product processing site).
- Local topography and hydrology.
- Local land use.
- Surrounding terrestrial habitat.
- Surrounding aquatic/wetlands habitat.
- Qualitative prediction of contaminant migration.
- Persistence and mobility of migrating contaminants.

Because of the limited current and future potential for this site to support any terrestrial flora or fauna of special concern, it was determined that the ecological assessment should focus on the real and potential impacts that site related contamination may have on the aquatic resources of the Rockaway River drainage.

Aquatic life may be exposed to contaminants of concern by direct contact with contaminated water and sediment and by ingestion of contaminated sediments and food. However, exposure and toxicity data (dose-response data) are seldom available to assess exposure via all of these pathways.

The potential toxicity associated with contaminant runoff and/or groundwater discharge into the Rockaway River will be evaluated for aquatic life using ambient water quality criteria EPA (1986), sediment biological effects data (NOAA, 1990), and appropriate aquatic toxicity values.

Ambient water quality criteria (AWQC) are developed to be protective of 95 percent of all aquatic species. Therefore, not only are fish protected, but aquatic invertebrates and plants are protected as well. Consequently, comparison of predicted surface water concentrations in the Rockaway with these criteria are used to determine the likelihood of adverse effects to aquatic life, and should be sufficiently protective of those species. Contaminants found in surface water for which no AWQC exists, were compared with appropriate aquatic toxicity values, where available.

Although no sediment specific quality criteria are currently available, three comparisons of sediment-derived contaminant data were made: (1) a comparison of sediment contaminant concentrations to guidelines published by the National Oceanic and Atmospheric Administration (NOAA, 1990), (2) a comparison of modeled interstitial water contaminant concentrations to AWQC for applicable contaminants not described in the NOAA document, and (3) a comparison of modeled interstitial water contaminant concentrations with appropriate aquatic toxicity data, when AWQC or NOAA values are not available.

The NOAA report on biological effects of sediment-sorbed contamination (NOAA, 1990) describes an environmental Effect Range-Low (ER-L) value as a concentration that is the lower 10th percentile of a range of sediment concentrations in which biological effects had been observed at many sites across the United States. This value is not to be construed as NOAA standards or criteria; however, it is useful for comparing Rockaway River sediment concentrations to known sediment effects levels. The estimation of interstitial water contaminant concentrations, from sediments, was developed by EPA (1988) as part of the Equilibrium Partitioning (EP) approach for deriving sediment quality criteria. The EP approach is based on two primary assumptions. First, it is assumed that interstitial water

concentration of the contaminants of concern are controlled by partitioning between the sediment and the water (at concentrations below saturation). Therefore, partitioning can be calculated from the quantity of sorbents in the sediment and the appropriate sorption coefficients (i.e., K_{OC} or K_D). Secondly, it is assumed that the toxicity and accumulation of the contaminants by benthic organisms is correlated to the interstitial (pore-water) concentration and not directly to the total concentration of the contaminant in the sediment. The EP approach conservatively assumes that the pore-water concentration is in equilibrium with the sediment concentration, and that the interstitial water is not diluted by the Rockaway River water flowing above. The EP approach calculations for all contaminants of concern in sediments are presented in Appendix A.

When AWQC or NOAA biological effect levels are unavailable, aquatic toxicity values are derived using reported values from the available literature.

6.5 TOXICITY ASSESSMENT

The toxicities of the contaminants of concern in surface waters and sediment were assessed for aquatic life. Comparisons of media contaminant concentrations to AWQC, NOAA sediment effect levels, and appropriate aquatic toxicity values obtained through a review of the scientific literature are presented in Tables 6-3 and 6-4. Surface water and sediment concentrations presented in Tables 6-3 and 6-4 are a summary of data collected at three surface water and eight sediment sampling locations in the Rockaway River downstream from Building 12 (see Figure 1-2).

The aquatic toxicity values selected for this assessment are the lowest exposure concentrations reported to be toxic (LOEC) or the highest concentrations associated with no adverse effect (NOEC). Only toxicity values for species similar to those expected in the Rockaway River or sensitive fresh water aquatic indicator species are used. Data on chronic or subchronic toxicity were used whenever available. For those contaminants of concern for which only acute lethality values (e.g., LC50) for aquatic wildlife are available, critical

toxicity values for this assessment are derived by dividing the acute toxicity value by an uncertainty factor. In evaluating the potential effects of pesticides on aquatic wildlife, EPA analyzed a subset of available concentration-effect data and suggested that if the environmental concentration is less than 1/10th the aquatic LC50, then no acute hazard can be presumed (Urban and Cook, 1986). This rule is adopted for this risk assessment and used to derive acute toxicity values for aquatic receptors by dividing acute lethality values by 10. For the sediment toxicity evaluation (Table 6-4) all appropriate toxicity values have been grouped under the title "Adverse Biological Effect Levels".

6.6 RISK CHARACTERIZATION

The following is a discussion of potential risks to aquatic life as a result of surface water and sediment contaminant concentrations in the Rockaway River, adjacent to the L.E. Carpenter facility. Risks to aquatic life are assessed by comparisons of contaminant concentrations to AWQC, NOAA sediment biological effects levels, and appropriate toxicity values. Contaminant concentrations that were found to exceed these levels may pose a potential threat to aquatic life.

Contaminant concentrations in surface water did not exceed AWQC for any of the ten inorganic contaminants identified (see Table 6-3).

The concentrations of calcium, magnesium, and sodium for which there are no applicable criteria or toxicity values, exceeded the one background concentration; however these concentrations are all approximately one order of magnitude below average annual concentrations determined for the Rockaway River as part of the New Jersey Water Resources Database (USGS, 1987). These results indicate that surface waters examined do not contain contaminant concentration levels that would likely pose a significant threat to aquatic life and that sediment-sorbed contaminants do not appear to be partitioning to any great extent, into the water column.

Sediment data was evaluated to determine if there were any identifiable patterns or trends in concentration distribution. Although no obvious trends were noticed, the highest concentrations for most of the organic contaminants were found in samples 1-3 and 2-6 which were located in the Rockaway adjacent to Area I (see Figure 1-2). In general, the highest inorganic sediment concentrations were found in Sample 1-2 which is located near Building 12, adjacent to the concrete retaining wall.

There is no general sediment toxicity criteria analogous to the EPA's AWQC; however, sediment contaminant concentrations did exceed the potential adverse biological effect level for two phthalate esters, several PAHs, antimony, chromium, copper, lead, and mercury. With the exception of indeno (1,2,3,cd) pyrene, those sediment and interstitial water concentrations that did exceed the biological effect levels did not exceed them by more than one order of magnitude. When the highest sediment concentrations are compared to background concentrations, only bis(2-ethylhexy)phthalate, mercury, and zinc exceed background by more than an order of magnitude. It should be noted that the concentrations of toluene and 2-methylnaphthene in sediments were detected at the highest concentrations in background samples and the mean background concentrations for butyl benzyl phthalate and all PAHs except napthalene also exceed the adverse biological effects levels. These results suggest that many of the organic contaminants found in sediments may have originated from sources other than the site.

PAHs vary substantially in their toxicity to aquatic organisms and tend to bioconcentrate with increasing molecular weight (Eisler, 1987). However, high molecular weight PAHs have low acute aquatic toxicity due to their low solubility and high sorption tendency. Because the more hydrophobic PAH; such as benzo(c)pyrene, benzo(g,h,i)perylene, dibenzo(c,h)anthracene, and indeno(1,2,3,c,d)pyrene, tend to absorb strongly to suspended particulates and have relatively rapid biotransformation rates, bioaccumulation and food chain transfer as the result of ingestion is limited (McCarthy et al., 1985). Similarly, Sanders et al. (1973) and Autian (1973) reported that phthalate esters are metabolized by many fish

and often aquatic organisms, and concluded that although phthalates can rapidly bioconcentrate, they are not likely to biomagnify.

In general the aquatic toxicity potential and bioconcentration rates of many potentially toxic inorganics like chromium, lead, and mercury is largely determined by their organic form. This information is often not included in standard laboratory analysis and thus the evaluation of their potential toxic effects on a system is difficult to assess.

Absolute conclusions regarding the potential environmental impacts of the L.E. Carpenter facility on the aquatic ecosystem of the Rockaway River cannot be made because of the uncertainties associated with the use of biological effects levels. For example, the applicability of ER-L levels, which are derived from marine and estuarine studies, to the freshwater conditions of the Rockaway River is debatable. In particular, the overall confidence in the accuracy of ER-L levels for PAHs is low, because of the high variability in the study results on which they were based (NOAA, 1990). Additional uncertainty in the risk characterization is associated with the conservative EP approach which does not consider the dilution effect that the Rockaway River may have on contaminant concentration in the interstitial water space. However, given the available data and limitations, it can be generally concluded that aquatic life inhabiting the sediments in the Rockaway River may be at increased risk from exposure to contamination.

6.7 REFERENCES

Bakker, E.M. Van Zinderen and J.F. Jawanski, 1980. Effects of Vanadium in the Canadian Environment. NRCC No. 18132. Ottawa, Canada.

ECOTOX (QSAR) 1990. Montana State University, Numerica, Technical Database Service, New York, NY.

Eisler, R., 1987. Polycyclic Aromatic Hydrocarbon Hazard to Fish, Wildlife, and Invertebrates: A Synoptic Review. USFWS Biological Report 85(1.11), Laurel, MD.

EPA (U.S. Environmental Protection Agency), 1986a. Endangerment Assessment Handbook, Office of Waste Programs Enforcement, Washington, DC. TR-693-24B.

EPA (U.S. Environmental Protection Agency), 1986b. Quality Criteria for Water 1986. Office of Water Regulations and Standards, Washington, DC. EPA 440/5-86-001.

EPA (U.S. Environmental Protection Agency), 1988. Interim Sediment Criteria Values for Nonpolar Hydrophobic Organic Contaminants. SCD No. 17. Washington D.C.

EPA (U.S. Environmental Protection Agency), 1989a. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A); Interim Final. EPA/540/1-89/002.

EPA (U.S. Environmental Protection Agency), 1989b. Interim Final Risk Assessment Guidance for Superfund: Volume II Environmental Evaluation Manual. EPA/540/1-89/001.

Kaup, E. 1990. Certified correspondence to C.R. Anderson, Environmental Affairs Manager, M.A. Hanna Co., from Edgar Kaup, P.E., Case Manager, NJDEP. (Dated: 28 August, 1990)

Meyer, F.L. and M.R. Ellersieck, 1986. Manual of Acute Toxicity Interpretation and Data Base for 410 Chemicals and 66 Species of Freshwater Animals. USFWS. Resource Pub. 160, Washington, D.C.

Murphy, P.M., 1980. A Manual for Toxicity Tests with Freshwater Macroinvertebrates and a Review of the Effects of Specific Toxicants. Institute of Science and Technology, Univ. of Wales, United Kingdom.

NOAA (National Oceanic and Atmospheric Administration), 1990. The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, U.S. Department of Commerce, Seattle, WA.

U.S. Geological Survey (USGS), 1987. Water Resources Data, New Jersey Water Year 1987. NJDEP.

Urban, D.J. and N.J. Cook, 1986. Ecological Risk Assessment, U.S. Environmental Protection Agency. Office of Pesticide Program, Washington, DC. EPA 540/9-85-001.

Table 6-3

Comparison of Surface Water Concentrations in the Rockaway River with Federal Ambient Water Quality Criteria on Appropriate Toxicity Values

Pollutant	Average Surface Water Concentrations (µg/L)	Freshwater AWQC or CTV (µg/L)	Source & Effect Level	Exceed Toxicity Value
Arsenic	2.42E-00	4.80E+01	Chronic AWQC (pentavalent form)	No
Barium	4.83E+01	3.20E+02	Murphy, 1980 (NOEC, *Daphnia m.*)	No
Calcium	4.75E+03	NA		
Chromium (Tri)	3.64E-00	2.10E+02[b]	Chronic AWQC	No
(Hex)	5.20E-01	1.10E+01	Chronic AWQC	No
Iron	9.16E+01	1.00E+03	Acute AWQC	No
Magnesium	3.52E+03	NA		
Manganese	1.36E+01	5.20E+03	Murphy, 1980 (NOEC, *Daphnia m.*)	No
Selenium	2.20E+00	3.50E+01	Chronic AWQC	No
Sodium	4.47E+03	NA		
Vanadium	1.76E+01	3.00E+03	Bakker and Jaworski, 1980 (LC50, *Pimephales promelas*)	No

[a]Assumed total chromium content is 1/8 hexavalent and 7/8 trivalent.
[b]Hardness dependent, Rockaway River hardness = 100 mg/L $CaCO_3$ (USGS, 1987)

Table 6-4

Comparison of Sediment Concentrations in the Rockaway River with Biological Effect Levels

Pollutant	Mean Sediment Concentration (µg/kg)	Mean Interstitial Sediment Water Concentration (µg/kg)	Adverse Biological Effect Levels (µg/kg)	Exceed Toxicity Values	Source and Effect Level
Organics					
Bis(2-ethylhexyl) phthalate	6.27E+03	7.17E+00	3.00E+00 (phthalate esters)	Yes	Fresh Water Chronic (AWQC)
Butyl benzyl phthalate	5.53E+02	3.25E+00	3.00E+00 (phthalate esters)	Yes	Fresh Water Chronic (AWQC)
Di-n-butyl phthalate	3.30E+02	2.49E+01	3.00E+00 (phthalate esters)	No	Fresh Water Chronic (AWQC)
Di-n-octyl phthalate	6.85E+02	--	--	--	--
Methyl ethyl ketone	1.78E+01	5.23E+01	6.31E+05	No	NOEC, (chronic), ECOTOX Database (1990)
Methylene chloride	5.90E+01	1.25E+02	1.86E+05	No	NOEC, (chronic), ECOTOX Database (1990)
Polycyclic aromatic hydrocarbon (PAHs)					
Acenaphthene	3.28E+02	---	1.50E+02	Yes	ER-L, NOAA (1990)
Acenaphthylene	3.63E+02	6.41E+00	1.50E+02	No	NOEC, (chronic), ECOTOX Database (1990)
Anthracene	5.28E+02	---	8.50E+01	Yes	ER-L, NOAA (1990)
Benzo(a)anthracene	9.09E+02	---	2.30E+02	Yes	ER-L, NOAA (1990)

Table 6-4
(continued)

Pollutant	Mean Sediment Concentration (µg/kg)	Mean Interstitial Sediment Water Concentration (µg/kg)	Adverse Biological Effect Levels (µg/kg)	Exceed Toxicity Values	Source and Effect Level
Benzo(a)pyrene	8.16E+02	---	4.00E+02	Yes	ER-L, NOAA (1990)
Benzo(b,k)fluoranthene	1.21E+03	---	NA	---	---
Benzo(g,h,i)perylene	6.76E+02	---	NA	---	---
Chrysene	9.95E+02	---	4.00E+02	Yes	ER-L, NOAA (1990)
Dibenzo(a,h)anthracene	3.38E+02	---	6.00E+01	Yes	ER-L, NOAA (1990)
Fluoranthene	1.35E+03	---	6.00E+02	Yes	ER-L, NOAA (1990)
Fluorene	4.65E+02	---	3.50E+01	Yes	ER-L, NOAA (1990)
Indeno(1,2,3,c,d)pyrene	5.42E+02	---	3.30E-01	Yes	LC50, Fathead Minnow, ECOTOX Database (1990)
2-Methylnaphthalene	2.00E+02	--[a]	NA	--	---
Naphthalene	2.51E+02	---	3.40E+02	Yes	ER-L, NOAA (1990)
Phenanthrene	1.17E+03	---	2.25E+02	Yes	ER-L, NOAA (1990)
Pyrene	1.30E+03	---	3.50E+02	Yes	ER-L, NOAA (1990)
TOTAL (PAHs)	1.14E+04	---	4.00E+03	Yes	ER-L, NOAA (1990)
Tetrachloroethene	3.56E+00	1.69E+00	8.40E+02	No	Fresh Water Chronic (AWQC)
Toluene	3.00E+00	3.00E+00	1.75E+04	No	Fresh Water Acute (AWQC)

Table 6-4
(continued)

Pollutant	Mean Sediment Concentration (µg/kg)	Mean Interstitial Sediment Water Concentration (µg/kg)	Adverse Biological Effect Levels (µg/kg)	Exceed Toxicity Values	Source and Effect Level
Xylene (total)	3.00E+00	1.25E+00	2.26E+02	No	LC50, Rainbow Trout, Mayer and Ellersieck (1986)
Inorganics	(mg/kg)	(mg/kg)	(mg/kg)		
Aluminum	2.91E+00	1.94E-03	3.20E-01	No	NOEC, *Daphnia magna*, Murphy (1980)
Antimony	8.37E+00	---	2.00E+00	Yes	ER-L, NOAA (1990)
Arsenic	7.91E+00	---	3.30E+01	No	ER-L, NOAA (1990)
Barium	1.01E+00	1.68E-02	3.20E-01	No	NOEC, *Daphnia magna*, Murphy (1980)
Cadmium	2.70E-01	---	5.00E+00	No	ER-L, NOAA (1990)
Calcium	2.38E+01	---	NA	---	---
Chromium (total)	3.17E+01	---	8.00E+01	Yes	ER-L, NOAA (1990)
Cobalt	1.49E-01	3.30E-03	NA	---	---
Copper	8.69E+01	---	7.00E+01	Yes	ER-L, NOAA (1990)
Iron	3.50E+00	1.14E-01	1.00E+00	No	Fresh Water Chronic (AWQC)
Lead	1.8E+02	---	3.50E+01	Yes	ER-L, NOAA (1990)
Magnesium	2.09E+01	4.64E+00	NA	---	---
Manganese	2.66E-01	4.09E-03	5.20E+00	No	NOEC, *Daphnia magna*, Murphy (1980)

Table 6-4
(continued)

Pollutant	Mean Sediment Concentration (µg/kg)	Mean Interstitial Sediment Water Concentration (µg/kg)	Adverse Biological Effect Levels (µg/kg)	Exceed Toxicity Values	Source and Effect Level
Mercury	3.5E-01	---	1.50E-01	Yes	ER-L, NOAA (1990)
Nickel	1.73E+01	---	3.00E+01	No	ER-L, NOAA (1990)
Potassium	1.20E+01	1.72E+01	NA	---	---
Sodium	9.56E+00	5.00E-01	NA	---	---
Vanadium	4.29E-01	4.20E-02	1.50E+00	No	LC50, Fathead minnow, Bakker and Jaworski (1980)
Zinc	2.58E+02	---	1.20E+02	No	ER-L, NOAA (1990)

NA = Not available
a = K_{oc} value not available; therefore, interstitial water concentration was not calculated.

APPENDIX A

EQUILIBRIUM PARTITION SCREENING ANALYSIS FOR CONTAMINANTS IN SEDIMENTS OF THE ROCKAWAY RIVER

APPENDIX A
EQUILIBRIUM PARTITION SCREENING ANALYSIS FOR CONTAMINANTS IN SEDIMENTS OF THE ROCKAWAY RIVER

Since there is evidence of fishing in the Rockaway River, a fish ingestion scenario was proposed. Although none of the contaminants evaluated in this analysis were detected in the water column, (i.e., surface water analysis) there is a concern that bottom feeding or predator fish could potentially incorporate these contaminants through the ingestion of sediments or benthic invertebrates living in those sediments. To estimate this, substances were partitioned into interstitial water by using the equation:

$$C_W = \frac{C_s}{K_D}$$

Where:

C_w = Concentration in water
C_s = Concentration in sediments
K_D = $K_{oc} * F_{oc}$

Where:

K_D = Sediment water distribution coefficient at equilibrium

K_{oc} = Organic carbon - water partition coefficient at equilibrium

F_{oc} = Fraction of organic carbon in sediment (1 %, USGS, 1987)

Source: EPA, 1988

This screening analysis was performed only for those substances found in sediments, and which were not detected in surface water. The predicted interstitial surface water concentrations from this analysis were then compared with Ambient Water Quality Criteria (AWQC) for the protection of Human Health to provide a conservative estimate of the potential risk due to the consumption of fish taken from those waters.

TABLE A-1.

COMPARISON OF CALCULATED INTERSTITIAL WATER CONTAMINANT CONCENTRATIONS WITH AMBIENT WATER QUALITY CRITERIA (AWQCs) FOR FISH INGESTION ONLY

CHEMICAL	AVERAGE (ug/kg)	CALCULATED INTERSTITIAL WATER CONCENTRATION (ug/L)	AWQC FOR FISH INGESTION ONLY (a) (ug/L)
ORGANICS			
Bis(2-ethylhexyl)phthalate	6.27E+03	7.17E+00	5.00E+04
Butyl benzyl phthalate	5.53E+02	3.25E+00	NA
Di-n-butyl phthlate	3.30E+02	2.49E+01	1.54E+05
Di-n-octyl phthalate	6.85E+02	---	NA
Methylene chloride	5.90E+01	1.26E+02	1.57E+01 (b)
Methyl ethyl ketone	1.78E+01	5.24E+01	NA
Naphthalene	2.51E+02	---	NA
Polycyclic aromatic hydrocarbons (PAHs)			
Acenaphthene	3.28E+02	4.01E+00	3.11E-02 (c)
Acenaphthylene	3.63E+02	6.41E+00	3.11E-02 (c)
Anthracene	5.28E+02	3.89E+00	3.11E-02 (c)
Benzo(a)anthracene	9.09E+02	4.63E-01	3.11E-02 (c)
Benzo(a)pyrene	8.16E+02	1.54E-01	3.11E-02 (c)
Benzo(b)fluoranthene/Benzo(k)fluoranthene	1.21E+03	6.76E-02	3.11E-02 (c)
Benzo(g,h,i)perylene	6.76E+02	8.26E-03	3.11E-02 (c)
Chrysene	9.95E+02	5.07E-01	3.11E-02 (c)
Dibenzo(a,h)anthracene	3.38E+02	7.51E-02	3.11E-02 (c)
Fluoranthene	1.35E+03	1.31E+00	5.40E+01
Fluorene	4.65E+02	6.38E+00	3.11E-02 (c)
Indeno(1,2,3,c,d)pyrene	5.42E+02	2.46E-03	3.11E-02 (c)
2-Methylnaphthalene	2.00E+02	---	NA
Phenanthrene	1.17E+03	8.42E+00	3.11E-02 (c)
Pyrene	1.30E+03	1.29E+00	3.11E-02 (c)
Total PAHs (excluding fluoranthene)	9.98E+03	3.17E+01	3.11E-02 (c)
Tetrachloroethene	3.56E+00	1.70E+00	8.85E+00 (c)
Toluene	3.00E+00	3.00E+00	4.24E+05 (c)
Xylenes (total)	3.00E+00	1.25E+00	NA
INORGANICS			
Aluminum	2.91E+03	1.94E+00	NA
Antimony	8.37E+03	1.86E+02	4.50E+04
Cadmium	2.70E+02	4.15E-01	3.43E+06
Chromium (as Cr III)	2.77E+04	3.26E+01	NA
Chromium (as Cr VI)	3.96E+03	4.66E+00	1.46E-01
Cobalt	1.49E+02	3.31E+00	1.00E+02
Mercury	3.50E+02	3.50E+01	
Nickel	1.73E+04	1.15E+02	
Potassium	1.20E+04	2.18E+03	
Zinc	2.58E+05	6.45E+03	

NA = Not available.

(a) EPA, 1986. Quality Criteria for Water 1986. OWRS, Washington DC. EPA 440/5-86-001

(b) AWQC for halomethanes used.

(c) AWQC for polyaromatic hydrocarbons used.

TABLE A-2

COMPARISON OF SURFACE WATER CONCENTRATION WITH AMBIENT WATER QUALITY CRITERIA (AWQCs) FOR FISH INGESTION ONLY

CHEMICAL	AVERAGE (ug/L)	AWQC FISH INGESTION ONLY (ug/L)
INORGANICS		
Arsenic	2.42E+00	1.75E-02
Barium	4.83E+01	NA
Calcium	4.75E+03	NA
Iron	9.16E+01	NA
Magnesium	3.52E+03	NA
Manganese	1.36E+01	1.00E+02
Selenium	2.20E+00	NA
Sodium	4.47E+03	NA
Vanadium	1.76E+01	NA

NA = Not available.

SOURCE: EPA, 1986. Quality Criteria for Water 1986. OWRS, Washington DC, EPA 440/5-86-001

Fish Ingestion Risk

Only two compounds which were detected in the surface water have AWQCs. Arsenic exceeded the criteria by two orders of magnitude, and therefore may be a cause of concern. Some of the compounds for which concentrations were modeled into interstitial space exceed the AWQCs. They are as follows:

Organics

Total PAHs[a]

Inorganics

Beryllium
Mercury
Nickel

---

[a]Does not include fluoranthene, which has its own AWQC value and is in concentrations below the value.

Both beryllium and nickel exceed their respective AWQC by less than an order of magnitude. Total PAHs have a calculated concentration in interstitial waters of 4.79E+01 μg/L, exceeding the AWQC of 3.11E-02 μg/L by over three orders of magnitude. Mercury, 1.50E-02 μg/L, is in excess of the AWQC of 1.46E-01 μg/L by three orders of magnitude. Since the derived concentrations are for interstitial water and not surface water, dilution factors have not been applied, and therefore overestimate (possibly be several orders of magnitude) the actual concentration in surface water. Compounds detected in sediment may not be a hazard in a fish ingestion scenario.

It was only possible to calculate the upper 95% confidence limit of the arithmetic mean for groundwater and soil data. Therefore these risk numbers were not used for calculation of total risk potential. The media risks however, are presented in tables within this section for general reader comparison.

APPENDIX B
EXPOSURE CONCENTRATIONS AND DAILY INTAKES

TABLE B-1. SHALLOW GROUNDWATER CONCENTRATIONS AND INGESTION DOSES FOR ALL RECEPTORS IN FUTURE USE SCENARIO

CHEMICAL	SHALLOW GROUNDWATER CONCENTRATION			ADULT			CHILD		
	AVERAGE (mg/L)	95% LIMIT (mg/L)	MAXIMUM (mg/L)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)
ORGANICS									
Bis(2-ethylhexyl)phthalate	1.57E-01	6.20E+01	6.20E+01	4.49E-03	1.77E+00	1.77E+00	1.05E-02	4.13E+00	4.13E+00
Butyl benzyl phthalate	1.37E-02	1.66E-01	3.50E-01	3.92E-04	4.75E-03	1.00E-02	9.14E-04	1.11E-02	2.33E-02
1,1-Dichloroethane	6.00E-03	1.04E-01	2.50E-01	1.71E-04	2.97E-03	7.14E-03	4.00E-04	6.92E-03	1.67E-02
1,1-Dichloroethene	3.22E-03	3.82E-03	4.60E-03	9.20E-05	1.09E-04	1.31E-04	2.15E-04	2.55E-04	3.07E-04
1,2-Dichloroethene (total)	4.15E-03	1.40E-02	2.50E-02	1.19E-04	4.01E-04	7.14E-04	2.77E-04	9.35E-04	1.67E-03
1,2-Diethylbenzene	9.80E-03	2.50E-02	1.00E-01	2.80E-04	7.15E-04	2.86E-03	6.53E-04	1.67E-03	6.67E-03
2,4-Dimethylphenol	1.10E-02	8.00E-02	1.80E-01	3.14E-04	2.29E-03	5.14E-03	7.34E-04	5.34E-03	1.20E-02
Di-n-butyl phthalate	1.03E-02	3.64E-02	1.10E-01	2.95E-04	1.04E-03	3.14E-03	6.89E-04	2.43E-03	7.33E-03
Di-n-octyl phthalate	1.38E-02	1.70E-01	5.35E-01	3.95E-04	4.86E-03	1.53E-02	9.23E-04	1.13E-02	3.57E-02
Ethylbenzene	4.66E-02	2.60E+01	2.60E+01	1.33E-03	7.43E-01	7.43E-01	3.11E-03	1.73E+00	1.73E+00
1-Ethyl-3-methylbenzene	1.69E-02	4.20E-01	4.20E-01	4.84E-04	1.20E-02	1.20E-02	1.13E-03	2.80E-02	2.80E-02
Isopropyl benzene	1.26E-02	5.05E-02	1.00E-01	3.60E-04	1.44E-03	2.86E-03	8.39E-04	3.37E-03	6.67E-03
Methylene chloride	2.84E-02	9.70E-01	9.70E-01	8.13E-04	2.77E-02	2.77E-02	1.90E-03	6.47E-02	6.47E-02
Naphthalene	2.53E-03	2.59E-03	2.85E-03	7.23E-05	7.40E-05	8.14E-05	1.69E-04	1.73E-04	1.90E-04
n-Butylbenzene	6.65E-03	1.05E-02	2.70E-02	1.90E-04	3.00E-04	7.71E-04	4.43E-04	6.99E-04	1.80E-03
n-Decane	2.45E-02	3.10E+00	3.10E+00	7.01E-04	8.86E-02	8.86E-02	1.63E-03	2.07E-01	2.07E-01
n-Nonane	1.36E-02	1.97E-01	7.05E-01	3.87E-04	5.63E-03	2.01E-02	9.04E-04	1.31E-02	4.70E-02
Phenol	1.05E-02	4.87E-02	1.20E-01	3.00E-04	1.39E-03	3.43E-03	6.99E-04	3.25E-03	8.00E-03
Tetrachloroethene	3.11E-03	3.57E-03	4.20E-03	8.89E-05	1.02E-04	1.20E-04	2.07E-04	2.38E-04	2.80E-04
1,2,3,4-Tetramethylbenzene	7.95E-03	2.17E-02	1.18E-01	2.27E-04	6.20E-04	3.36E-03	5.30E-04	1.45E-03	7.83E-03
Toluene	8.11E-03	1.10E-01	1.10E-01	2.32E-04	3.14E-03	3.14E-03	5.40E-04	7.33E-03	7.33E-03
1,1,1-Trichloroethane	2.81E-03	3.01E-03	3.50E-03	8.04E-05	8.61E-05	1.00E-04	1.88E-04	2.01E-04	2.33E-04
Trichloroethene	3.28E-03	3.94E-03	4.80E-03	9.37E-05	1.13E-04	1.37E-04	2.19E-04	2.63E-04	3.20E-04
1,2,3-Trimethylbenzene/1,2,4-Trimethylbenzene	3.83E-02	4.07E-01	4.57E-01	1.09E-03	1.16E-02	1.31E-02	2.55E-03	2.72E-02	3.05E-02
1,3,5-Trimethylbenzene	2.25E-02	4.90E-01	4.90E-01	6.44E-04	1.40E-02	1.40E-02	1.50E-03	3.27E-02	3.27E-02
Xylenes (Total)	1.40E-01	1.20E+02	1.20E+02	3.99E-03	3.43E+00	3.43E+00	9.31E-03	8.00E+00	8.00E+00

TABLE B-1. SHALLOW GROUNDWATER CONCENTRATIONS AND INGESTION DOSES FOR ALL RECEPTORS IN FUTURE USE SCENARIO

	SHALLOW GROUNDWATER CONCENTRATION			ADULT			CHILD		
CHEMICAL	AVERAGE (mg/L)	95% LIMIT (mg/L)	MAXIMUM (mg/L)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)
INORGANICS									
Antimony	9.22E-02	4.83E-01	5.49E-01	2.63E-03	1.38E-02	1.57E-02	6.14E-03	3.22E-02	3.66E-02
Arsenic	7.09E-03	1.78E-02	3.17E-02	2.03E-04	5.10E-04	9.06E-04	4.73E-04	1.19E-03	2.11E-03
Copper	1.19E-02	2.65E-02	8.91E-02	3.39E-04	7.57E-04	2.54E-03	7.90E-04	1.77E-03	5.94E-03
Nickel	5.45E-03	7.01E-02	7.01E-02	1.56E-04	2.00E-03	2.00E-03	3.63E-04	4.67E-03	4.67E-03
Selenium	2.71E-03	3.94E-03	8.63E-03	7.73E-05	1.12E-04	2.46E-04	1.80E-04	2.62E-04	5.75E-04
Zinc	6.48E-02	2.09E-01	2.24E-01	1.85E-03	5.97E-03	6.40E-03	4.32E-03	1.39E-02	1.49E-02
				DOSE = CW*IR/BW CW = concentration in water IR = ingestion rate (2 L/day) BW = body weight (70 kg)			DOSE = CW*IR/BW CW = concentration in water IR = ingestion rate (1 L/day) BW = body weight (15 kg)		

TABLE B-2. INTERMEDIATE GROUNDWATER CONCENTRATIONS AND INGESTION DOSES FOR ALL RECEPTORS IN FUTURE USE SCENARIO

	INTERMEDIATE GROUNDWATER CONCENTRATION			ADULT			CHILD		
CHEMICAL	AVERAGE (mg/L)	95% LIMIT (mg/L)	MAXIMUM (mg/L)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)
ORGANICS									
Bis(2-ethylhexyl)phthalate	5.52E-03	3.23E-02	4.10E-02	1.58E-04	9.22E-04	1.17E-03	3.68E-04	2.15E-03	2.73E-03
2,4-Dimethylphenol	7.41E-03	2.73E-02	4.06E-02	2.12E-04	7.80E-04	1.16E-03	4.94E-04	1.82E-03	2.71E-03
Ethylbenzene	3.78E-03	3.59E-02	4.53E-02	1.08E-04	1.03E-03	1.29E-03	2.52E-04	2.39E-03	3.02E-03
Xylenes (Total)	5.08E-03	3.56E-01	3.56E-01	1.45E-04	1.02E-02	1.02E-02	3.38E-04	2.37E-02	2.37E-02
INORGANICS									
Arsenic	4.02E-03	4.45E-03	5.00E-03	1.15E-04	1.27E-04	1.43E-04	2.68E-04	2.97E-04	3.33E-04
Chromium (as Cr III)	6.20E-03	3.43E-02	5.01E-02	1.77E-04	9.80E-04	1.43E-03	4.13E-04	2.29E-03	3.34E-03
Chromium (as Cr VI)	8.85E-04	4.90E-03	7.16E-03	2.53E-05	1.40E-04	2.04E-04	5.90E-05	3.27E-04	4.77E-04
Copper	6.56E-03	1.07E-02	1.51E-02	1.87E-04	3.05E-04	4.31E-04	4.37E-04	7.12E-04	1.01E-03
Nickel	4.27E-02	1.02E+00	1.02E+00	1.22E-03	2.91E-02	2.91E-02	2.85E-03	6.80E-02	6.80E-02
Selenium	2.49E-03	2.50E-03	2.50E-03	7.10E-05	7.14E-05	7.14E-05	1.66E-04	1.67E-04	1.67E-04
Zinc	2.94E-02	2.29E-01	2.29E-01	8.41E-04	6.53E-03	6.53E-03	1.96E-03	1.52E-02	1.52E-02
				DOSE = CW*IR/BW CW = concentration in water IR = ingestion rate (2 L/day) BW = body weight (70 kg)			DOSE = CW*IR/BW CW = concentration in water IR = ingestion rate (1 L/day) BW = body weight (15 kg)		

TABLE B-3. DEEP GROUNDWATER CONCENTRATIONS AND INGESTION DOSES FOR ALL RECEPTORS IN FUTURE USE SCENARIO

	DEEP GROUNDWATER CONCENTRATION			ADULT			CHILD		
CHEMICAL	AVERAGE (mg/L)	95% LIMIT (mg/L)	MAXIMUM (mg/L)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)
ORGANICS									
Bis(2-ethylhexyl)phthalate	1.44E-02	1.80E+00	1.80E+00	4.11E-04	5.15E-02	5.15E-02	9.60E-04	1.20E-01	1.20E-01
1,2-Dichloroethane	1.48E-03	1.70E-03	1.70E-03	4.23E-05	4.86E-05	4.86E-05	9.87E-05	1.13E-04	1.13E-04
Diethylphthalate	2.20E-03	2.20E-03	2.20E-03	6.29E-05	6.29E-05	6.29E-05	1.47E-04	1.47E-04	1.47E-04
INORGANICS									
Chromium (as Cr III)	4.59E-03	1.11E-02	1.11E-02	1.31E-04	3.18E-04	3.18E-04	3.06E-04	7.41E-04	7.41E-04
Chromium (as Cr VI)	6.56E-04	1.59E-03	1.59E-03	1.87E-05	4.54E-05	4.54E-05	4.37E-05	1.06E-04	1.06E-04
Copper	6.09E-03	1.14E-02	1.27E-02	1.74E-04	3.25E-04	3.61E-04	4.06E-04	7.59E-04	8.43E-04
Lead	2.47E-03	4.75E-03	4.75E-03	7.07E-05	1.36E-04	1.36E-04	1.65E-04	3.17E-04	3.17E-04
Zinc	2.17E-02	3.50E-01	3.50E-01	6.20E-04	1.00E-02	1.00E-02	1.45E-03	2.33E-02	2.33E-02
				DOSE = CW*IR/BW CW = concentration in water IR = ingestion rate (2 L/day) BW = body weight (70 kg)			DOSE = CW*IR/BW CW = concentration in water IR = ingestion rate (1 L/day) BW = body weight (15 kg)		

TABLE B-4. SHALLOW GROUNDWATER CONCENTRATIONS AND NON-INGESTION DOSES FOR ALL RECEPTORS IN FUTURE USE SCENARIO

CHEMICAL	CONCENTRATION			ADULT			CHILD		
	AVERAGE (mg/L)	95% LIMIT (mg/L)	MAXIMUM (mg/L)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)
ORGANICS									
1,1-Dichloroethane	6.00E-03	1.04E-01	2.50E-01	1.71E-04	2.97E-03	7.14E-03	4.00E-04	6.92E-03	1.67E-02
1,1-Dichloroethene	3.22E-03	3.82E-03	4.60E-03	9.20E-05	1.09E-04	1.31E-04	2.15E-04	2.55E-04	3.07E-04
1,2-Dichloroethene (total)	4.15E-03	1.40E-02	2.50E-02	1.19E-04	4.01E-04	7.14E-04	2.77E-04	9.35E-04	1.67E-03
Ethylbenzene	4.66E-02	2.60E+01	2.60E+01	1.33E-03	7.43E-01	7.43E-01	3.11E-03	1.73E+00	1.73E+00
Methylene chloride	2.84E-02	9.70E-01	9.70E-01	8.13E-04	2.77E-02	2.77E-02	1.90E-03	6.47E-02	6.47E-02
Tetrachloroethene	3.11E-03	3.57E-03	4.20E-03	8.89E-05	1.02E-04	1.20E-04	2.07E-04	2.38E-04	2.80E-04
Toluene	8.11E-03	1.10E-01	1.10E-01	2.32E-04	3.14E-03	3.14E-03	5.40E-04	7.33E-03	7.33E-03
1,1,1-Trichloroethane	2.81E-03	3.01E-03	3.50E-03	8.04E-05	8.61E-05	1.00E-04	1.88E-04	2.01E-04	2.33E-04
Trichloroethene	3.28E-03	3.94E-03	4.80E-03	9.37E-05	1.13E-04	1.37E-04	2.19E-04	2.63E-04	3.20E-04
Xylenes (Total)	1.40E-01	1.20E+02	1.20E+02	3.99E-03	3.43E+00	3.43E+00	9.31E-03	8.00E+00	8.00E+00
				DOSE = CW*IRCE/BW CW = concentration in water IRCE = inhalation rate concentration equivalent (2 L/day) BW = body weight (70 kg)			DOSE = CW*IRCE/BW CW = concentration in water IRCE = inhalation rate concentration equivalent (1 L/day) BW = body weight (15 kg)		

TABLE B-5. INTERMEDIATE GROUNDWATER CONCENTRATIONS AND NON-INGESTION DOSES FOR ALL RECEPTORS IN FUTURE USE SCENARIO

CHEMICAL	CONCENTRATION			ADULT			CHILD		
	AVERAGE (mg/L)	95% LIMIT (mg/L)	MAXIMUM (mg/L)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)
ORGANICS									
Ethylbenzene	3.78E-03	3.59E-02	4.53E-02	1.08E-04	1.03E-03	1.29E-03	2.52E-04	2.39E-03	3.02E-03
Xylenes (Total)	5.08E-03	3.56E-01	3.56E-01	1.45E-04	1.02E-02	1.02E-02	3.38E-04	2.37E-02	2.37E-02
				DOSE = CW*IRCE/BW CW = concentration in water IRCE = inhalation rate concentration equivalent (2 L/day) BW = body weight (70 kg)			DOSE = CW*IRCE/BW CW = concentration in water IRCE = inhalation rate concentration equivalent (1 L/day) BW = body weight (15 kg)		

TABLE B-6. DEEP GROUNDWATER CONCENTRATIONS AND NON-INGESTION DOSES FOR ALL RECEPTORS IN FUTURE USE SCENARIO

CHEMICAL	CONCENTRATION			ADULT			CHILD		
	AVERAGE (mg/L)	95% LIMIT (mg/L)	MAXIMUM (mg/L)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)
ORGANICS									
1,2-Dichloroethane	1.48E-03	1.70E-03	1.70E-03	4.23E-05	4.86E-05	4.86E-05	9.87E-05	1.13E-04	1.13E-04
				DOSE = CW*IRCE/BW CW = concentration in water IRCE = inhalation rate concentration equivalent (2 L/day) BW = body weight (70 kg)			DOSE = CW*IRCE/BW CW = concentration in water IRCE = inhalation rate concentration equivalent (1 L/day) BW = body weight (15 kg)		

TABLE B-7. SOIL CONCENTRATIONS AND INGESTION DOSES FOR ALL RECEPTORS IN PRESENT AND FUTURE USE SCENARIOS

	SOIL CONCENTRATIONS			WORKER			TRESPASSER			ADULT			CHILD		
CHEMICAL	AVERAGE (mg/kg)	95% LIMIT (mg/kg)	MAXIMUM (mg/kg)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)
ORGANICS															
Acetone	1.09E-01	8.60E+01	8.60E+01	7.79E-08	6.14E-05	6.14E-05	9.76E-08	7.69E-05	7.69E-05	1.56E-07	1.23E-04	1.23E-04	1.45E-06	1.15E-03	1.15E-03
Aroclor 1254	4.19E-01	3.28E+00	1.80E+01	2.99E-07	2.34E-06	1.29E-05	3.75E-07	2.93E-06	1.61E-05	5.99E-07	4.68E-06	2.57E-05	5.59E-06	4.37E-05	2.40E-04
Benzene	3.43E-02	3.43E+01	3.43E+01	2.45E-08	2.45E-05	2.45E-05	3.07E-08	3.07E-05	3.07E-05	4.90E-08	4.90E-05	4.90E-05	4.57E-07	4.57E-04	4.57E-04
Bis(2-ethylhexyl)phthalate	1.37E+02	3.00E+04	3.00E+04	9.82E-05	2.14E-02	2.14E-02	1.23E-04	2.68E-02	2.68E-02	1.96E-04	4.29E-02	4.29E-02	1.83E-03	4.00E-01	4.00E-01
Butyl benzyl phthalate	1.95E-01	4.59E+00	1.40E+02	1.39E-07	3.28E-06	1.00E-04	1.75E-07	4.11E-06	1.25E-04	2.79E-07	6.56E-06	2.00E-04	2.60E-06	6.12E-05	1.87E-03
Di-n-butyl phthalate	2.21E-01	6.65E-01	3.00E+01	1.58E-07	4.75E-07	2.14E-05	1.97E-07	5.95E-07	2.68E-05	3.15E-07	9.50E-07	4.29E-05	2.94E-06	8.87E-06	4.00E-04
Di-n-octyl phthalate	5.27E-01	4.08E+00	5.90E+02	3.77E-07	2.91E-06	4.21E-04	4.72E-07	3.65E-06	5.28E-04	7.53E-07	5.83E-06	8.43E-04	7.03E-06	5.44E-05	7.87E-03
Ethylbenzene	1.27E-02	1.70E+03	1.70E+03	9.06E-09	1.21E-03	1.21E-03	1.13E-08	1.52E-03	1.52E-03	1.81E-08	2.43E-03	2.43E-03	1.69E-07	2.27E-02	2.27E-02
Methylene chloride	1.57E-01	3.10E+02	3.10E+02	1.12E-07	2.21E-04	2.21E-04	1.40E-07	2.77E-04	2.77E-04	2.24E-07	4.43E-04	4.43E-04	2.09E-06	4.13E-03	4.13E-03
Methyl ethyl ketone	3.24E-03	2.46E-01	9.50E+01	2.32E-09	1.76E-07	6.79E-05	2.90E-09	2.20E-07	8.50E-05	4.63E-09	3.51E-07	1.36E-04	4.32E-08	3.28E-06	1.27E-03
Polycyclic aromatic hydrocarbons (PAHs)															
Benzo(a)anthracene	9.72E-02	2.17E-01	2.70E+01	6.95E-08	1.55E-07	1.93E-05	8.70E-08	1.94E-07	2.42E-05	1.39E-07	3.10E-07	3.86E-05	1.30E-06	2.89E-06	3.60E-04
				2.92E-07	1.55E-07	1.93E-05	3.65E-07	1.94E-07	2.42E-05	5.83E-07	3.09E-07	3.86E-05	5.44E-06	2.89E-06	3.60E-04
Benzo(a)pyrene	8.62E-02	1.53E-01	2.30E+00	6.16E-08	1.09E-07	1.64E-06	7.71E-08	1.37E-07	2.06E-06	1.23E-07	2.19E-07	3.29E-06	1.15E-06	2.04E-06	3.07E-05
				1.03E-07	1.09E-07	1.64E-06	1.29E-07	1.37E-07	2.06E-06	2.07E-07	2.19E-07	3.29E-06	1.93E-06	2.04E-06	3.07E-05
Benzo(b)fluoranthene/Benzo(k)fluoranthene	1.29E-01	2.81E-01	1.60E+00	9.19E-08	2.01E-07	1.14E-06	1.15E-07	2.51E-07	1.43E-06	1.84E-07	4.01E-07	2.29E-06	1.72E-06	3.75E-06	2.13E-05
				1.70E-07	2.01E-07	1.14E-06	2.13E-07	2.51E-07	1.43E-06	3.40E-07	4.01E-07	2.29E-06	3.17E-06	3.74E-06	2.13E-05
Benzo(g,h,i)perylene	8.01E-02	1.42E-01	1.60E+00	5.72E-08	1.01E-07	1.14E-06	7.16E-08	1.27E-07	1.43E-06	1.14E-07	2.03E-07	2.29E-06	1.07E-06	1.89E-06	2.13E-05
Chrysene	9.58E-02	2.10E-01	2.60E+00	6.84E-08	1.50E-07	1.86E-06	8.57E-08	1.88E-07	2.33E-06	1.37E-07	3.00E-07	3.71E-06	1.28E-06	2.80E-06	3.47E-05
				1.34E-07	1.50E-07	1.86E-06	1.68E-07	1.88E-07	2.33E-06	2.69E-07	3.00E-07	3.71E-06	2.51E-06	2.80E-06	3.47E-05
Dibenzo(a,h)anthracene	4.37E-02	5.04E-02	9.50E-01	3.12E-08	3.60E-08	6.79E-07	3.91E-08	4.51E-08	8.50E-07	6.24E-08	7.20E-08	1.36E-06	5.82E-07	6.72E-07	1.27E-05
				3.79E-08	3.60E-08	6.79E-07	4.74E-08	4.51E-08	8.50E-07	7.57E-08	7.20E-08	1.36E-06	7.07E-07	6.72E-07	1.27E-05
Fluoranthene	5.65E-02	2.34E-01	4.40E+00	4.03E-08	1.67E-07	3.14E-06	5.05E-08	2.09E-07	3.94E-06	8.07E-08	3.34E-07	6.29E-06	7.53E-07	3.12E-06	5.87E-05
Indeno(1,2,3,c,d)pyrene	7.74E-02	1.21E-01	3.70E-01	5.53E-08	8.64E-08	2.64E-07	6.93E-08	1.08E-07	3.31E-07	1.11E-07	1.73E-07	5.29E-07	1.03E-06	1.61E-06	4.93E-06
				7.75E-08	8.66E-08	2.64E-07	9.70E-08	1.08E-07	3.31E-07	1.55E-07	1.73E-07	5.29E-07	1.45E-06	1.62E-06	4.93E-06
Phenanthrene	9.70E-02	2.77E-01	7.00E+00	6.93E-08	1.98E-07	5.00E-06	8.67E-08	2.48E-07	6.26E-06	1.39E-07	3.96E-07	1.00E-05	1.29E-06	3.69E-06	9.33E-05
Pyrene	1.05E-01	2.39E-01	3.90E+00	7.51E-08	1.71E-07	2.79E-06	9.40E-08	2.14E-07	3.49E-06	1.50E-07	3.41E-07	5.57E-06	1.40E-06	3.19E-06	5.20E-05
Tetrachloroethene	3.33E-03	3.72E-03	1.80E-02	2.38E-09	2.66E-09	1.29E-08	2.98E-09	3.33E-09	1.61E-08	4.76E-09	5.31E-09	2.57E-08	4.44E-08	4.96E-08	2.40E-07
Toluene	3.01E-03	1.03E-02	3.70E+01	2.15E-09	7.36E-09	2.64E-05	2.69E-09	9.21E-09	3.31E-05	4.30E-09	1.47E-08	5.29E-05	4.02E-08	1.37E-07	4.93E-04
Xylenes (total)	6.36E-02	7.40E+03	7.40E+03	4.54E-08	5.29E-03	5.29E-03	5.69E-08	6.62E-03	6.62E-03	9.08E-08	1.06E-02	1.06E-02	8.48E-07	9.87E-02	9.87E-02
INORGANICS															
Chromium (as Cr III)	1.80E+01	3.32E+01	4.31E+02	1.29E-05	2.37E-05	3.08E-04	1.61E-05	2.97E-05	3.86E-04	2.57E-05	4.74E-05	6.16E-04	2.40E-04	4.42E-04	5.75E-03
Chromium (as Cr VI)	2.57E+00	4.74E+00	6.16E+01	1.84E-06	3.38E-06	4.40E-05	2.30E-06	4.24E-06	5.51E-05	3.67E-06	6.77E-06	8.80E-05	3.43E-05	6.32E-05	8.22E-04

TABLE B-7. SOIL CONCENTRATIONS AND INGESTION DOSES FOR ALL RECEPTORS IN PRESENT AND FUTURE USE SCENARIOS

	SOIL CONCENTRATIONS			WORKER			TRESPASSER			ADULT			CHILD		
CHEMICAL	AVERAGE (mg/kg)	95% LIMIT (mg/kg)	MAXIMUM (mg/kg)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)
Copper	4.71E+01	8.85E+01	2.37E+02	3.37E-05	6.32E-05	1.69E-04	4.22E-05	7.91E-05	2.12E-04	6.73E-05	1.26E-04	3.39E-04	6.28E-04	1.18E-03	3.16E-03
Nickel	1.31E+01	2.14E+01	8.98E+01	9.32E-06	1.53E-05	6.41E-05	1.17E-05	1.91E-05	8.03E-05	1.86E-05	3.06E-05	1.28E-04	1.74E-04	2.85E-04	1.20E-03
Zinc	1.30E+02	2.64E+02	2.75E+03	9.31E-05	1.89E-04	1.96E-03	1.17E-04	2.36E-04	2.46E-03	1.86E-04	3.77E-04	3.93E-03	1.74E-03	3.52E-03	3.67E-02
Cyanide	1.02E+00	1.40E+00	1.40E+00	7.28E-07	1.00E-06	1.00E-06	9.12E-07	1.25E-06	1.25E-06	1.46E-06	2.00E-06	2.00E-06	1.36E-05	1.87E-05	1.87E-05
				DOSE = CS * SIR/BW CS = concentration in soil (mg/kg) SIR = soil ingestion rate (5.00E-05 kg/day) BW = body weight (70 kg)			DOSE = CS * SIR/BW CS = concentration in soil (mg/kg) SIR = soil ingestion rate (5.00E-05 kg/day) BW = body weight (55.9 kg)			DOSE = CS * SIR/BW CS = concentration in soil (mg/kg) SIR = soil ingestion rate (1.00E-04 kg/day) BW = body weight (70 kg)			DOSE = CS * SIR/BW CS = concentration in soil (mg/kg) SIR = soil ingestion rate (2.00E-04 kg/day) BW = body weight (15 kg)		

TABLE B-8. SOIL CONCENTRATIONS AND INHALATION DOSES FOR ALL RECEPTORS IN PRESENT AND FUTURE USE SCENARIOS

	SOIL CONCENTRATIONS			WORKER			TRESPASSER			ADULT			CHILD		
CHEMICAL	AVERAGE (mg/kg)	95% LIMIT (mg/kg)	MAXIMUM (mg/kg)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)
ORGANICS															
Acetone	1.09E-01	8.60E+01	8.60E+01	9.35E-10	7.37E-07	7.37E-07	9.76E-11	7.69E-08	7.69E-08	9.35E-10	7.37E-07	7.37E-07	5.59E-09	4.40E-06	4.40E-06
Aroclor 1254	4.19E-01	3.28E+00	1.80E+01	3.59E-09	2.81E-08	1.54E-07	3.75E-10	2.93E-09	1.61E-08	3.59E-09	2.81E-08	1.54E-07	2.15E-08	1.68E-07	9.22E-07
Benzene	3.43E-02	3.43E+01	3.43E+01	2.94E-10	2.94E-07	2.94E-07	3.07E-11	3.07E-08	3.07E-08	2.94E-10	2.94E-07	2.94E-07	1.76E-09	1.76E-06	1.76E-06
Bis(2-ethylhexyl)phthalate	1.37E+02	3.00E+04	3.00E+04	1.18E-06	2.57E-04	2.57E-04	1.23E-07	2.68E-05	2.68E-05	1.18E-06	2.57E-04	2.57E-04	7.04E-06	1.54E-03	1.54E-03
Butyl benzyl phthalate	1.95E-01	4.59E+00	1.40E+02	1.67E-09	3.93E-08	1.20E-06	1.75E-10	4.11E-09	1.25E-07	1.67E-09	3.93E-08	1.20E-06	9.99E-09	2.35E-07	7.17E-06
Di-n-butyl phthalate	2.21E-01	6.65E-01	3.00E+01	1.89E-09	5.70E-09	2.57E-07	1.97E-10	5.95E-10	2.68E-08	1.89E-09	5.70E-09	2.57E-07	1.13E-08	3.40E-08	1.54E-06
Di-n-octyl phthalate	5.27E-01	4.08E+00	5.90E+02	4.52E-09	3.50E-08	5.06E-06	4.72E-10	3.65E-09	5.28E-07	4.52E-09	3.50E-08	5.06E-06	2.70E-08	2.09E-07	3.02E-05
Ethylbenzene	1.27E-02	1.70E+03	1.70E+03	1.09E-10	1.46E-05	1.46E-05	1.13E-11	1.52E-06	1.52E-06	1.09E-10	1.46E-05	1.46E-05	6.50E-10	8.70E-05	8.70E-05
Methylene chloride	1.57E-01	3.10E+02	3.10E+02	1.34E-09	2.66E-06	2.66E-06	1.40E-10	2.77E-07	2.77E-07	1.34E-09	2.66E-06	2.66E-06	8.02E-09	1.59E-05	1.59E-05
Methyl ethyl ketone	3.24E-03	2.46E-01	9.50E+01	2.78E-11	2.11E-09	8.14E-07	2.90E-12	2.20E-10	8.50E-08	2.78E-11	2.11E-09	8.14E-07	1.66E-10	1.26E-08	4.86E-06
Polycyclic aromatic hydrocarbons (PAHs)															
Benzo(a)anthracene	9.72E-02	2.17E-01	2.70E+01	8.33E-10	1.86E-09	2.31E-07	8.70E-11	1.94E-10	2.42E-08	8.33E-10	1.86E-09	2.31E-07	4.98E-09	1.11E-08	1.38E-06
				3.50E-09	1.86E-09	2.31E-07	3.65E-10	1.94E-10	2.42E-08	3.50E-09	1.86E-09	2.31E-07	2.09E-08	1.11E-08	1.38E-06
Benzo(a)pyrene	8.62E-02	1.53E-01	2.30E+00	7.39E-10	1.31E-09	1.97E-08	7.71E-11	1.37E-10	2.06E-09	7.39E-10	1.31E-09	1.97E-08	4.41E-09	7.83E-09	1.18E-07
				1.24E-09	1.31E-09	1.97E-08	1.29E-10	1.37E-10	2.06E-09	1.24E-09	1.31E-09	1.97E-08	7.40E-09	7.85E-09	1.18E-07
Benzo(b)fluoranthene/Benzo(k)fluoranthene	1.29E-01	2.81E-01	1.60E+00	1.10E-09	2.41E-09	1.37E-08	1.15E-10	2.51E-10	1.43E-09	1.10E-09	2.41E-09	1.37E-08	6.59E-09	1.44E-08	8.19E-08
				2.04E-09	2.41E-09	1.37E-08	2.13E-10	2.51E-10	1.43E-09	2.04E-09	2.41E-09	1.37E-08	1.22E-08	1.44E-08	8.19E-08
Benzo(g,h,i)perylene	8.01E-02	1.42E-01	1.60E+00	6.86E-10	1.22E-09	1.37E-08	7.16E-11	1.27E-10	1.43E-09	6.86E-10	1.22E-09	1.37E-08	4.10E-09	7.27E-09	8.19E-08
Chrysene	9.58E-02	2.10E-01	2.60E+00	8.21E-10	1.80E-09	2.23E-08	8.57E-11	1.88E-10	2.33E-09	8.21E-10	1.80E-09	2.23E-08	4.91E-09	1.08E-08	1.33E-07
				1.61E-09	1.80E-09	2.23E-08	1.68E-10	1.88E-10	2.33E-09	1.61E-09	1.80E-09	2.23E-08	9.63E-09	1.07E-08	1.33E-07
Dibenzo(a,h)anthracene	4.37E-02	5.04E-02	9.50E-01	3.74E-10	4.32E-10	8.14E-09	3.91E-11	4.51E-11	8.50E-10	3.74E-10	4.32E-10	8.14E-09	2.24E-09	2.58E-09	4.86E-08
				4.54E-10	4.32E-10	8.14E-09	4.74E-11	4.51E-11	8.50E-10	4.54E-10	4.32E-10	8.14E-09	2.71E-09	2.58E-09	4.86E-08
Fluoranthene	5.65E-02	2.34E-01	4.40E+00	4.84E-10	2.01E-09	3.77E-08	5.05E-11	2.09E-10	3.94E-09	4.84E-10	2.01E-09	3.77E-08	2.89E-09	1.20E-08	2.25E-07
Indeno(1,2,3,c,d)pyrene	7.74E-02	1.21E-01	3.70E-01	6.64E-10	1.04E-09	3.17E-09	6.93E-11	1.08E-10	3.31E-10	6.64E-10	1.04E-09	3.17E-09	3.96E-09	6.20E-09	1.89E-08
				9.30E-10	1.04E-09	3.17E-09	9.70E-11	1.08E-10	3.31E-10	9.30E-10	1.04E-09	3.17E-09	5.55E-09	6.21E-09	1.89E-08
Phenanthrene	9.70E-02	2.77E-01	7.00E+00	8.31E-10	2.37E-09	6.00E-08	8.67E-11	2.48E-10	6.26E-09	8.31E-10	2.37E-09	6.00E-08	4.97E-09	1.42E-08	3.58E-07
Pyrene	1.05E-01	2.39E-01	3.90E+00	9.01E-10	2.05E-09	3.34E-08	9.40E-11	2.14E-10	3.49E-09	9.01E-10	2.05E-09	3.34E-08	5.38E-09	1.22E-08	2.00E-07
Tetrachloroethene	3.33E-03	3.72E-03	1.80E-02	2.85E-11	3.19E-11	1.54E-10	2.98E-12	3.33E-12	1.61E-11	2.85E-11	3.19E-11	1.54E-10	1.70E-10	1.90E-10	9.22E-10
Toluene	3.01E-03	1.03E-02	3.70E+01	2.58E-11	8.83E-11	3.17E-07	2.69E-12	9.21E-12	3.31E-08	2.58E-11	8.83E-11	3.17E-07	1.54E-10	5.27E-10	1.89E-06
Xylenes (total)	6.36E-02	7.40E+03	7.40E+03	5.45E-10	6.34E-05	6.34E-05	5.69E-11	6.62E-06	6.62E-06	5.45E-10	6.34E-05	6.34E-05	3.25E-09	3.79E-04	3.79E-04
INORGANICS															
Chromium (as Cr III)	1.80E+01	3.32E+01	4.31E+02	1.54E-07	2.84E-07	3.70E-06	1.61E-08	2.97E-08	3.86E-07	1.54E-07	2.84E-07	3.70E-06	9.22E-07	1.70E-06	2.21E-05
Chromium (as Cr VI)	2.57E+00	4.74E+00	6.16E+01	2.20E-08	4.06E-08	5.28E-07	2.30E-09	4.24E-09	5.51E-08	2.20E-08	4.06E-08	5.28E-07	1.32E-07	2.43E-07	3.16E-06

TABLE B-8. SOIL CONCENTRATIONS AND INHALATION DOSES FOR ALL RECEPTORS IN PRESENT AND FUTURE USE SCENARIOS

	SOIL CONCENTRATIONS			WORKER			TRESPASSER			ADULT			CHILD		
CHEMICAL	AVERAGE (mg/kg)	95% LIMIT (mg/kg)	MAXIMUM (mg/kg)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)
Copper	4.71E+01	8.85E+01	2.37E+02	4.04E-07	7.58E-07	2.03E-06	4.22E-08	7.91E-08	2.12E-07	4.04E-07	7.58E-07	2.03E-06	2.41E-06	4.53E-06	1.21E-05
Nickel	1.31E+01	2.14E+01	8.98E+01	1.12E-07	1.83E-07	7.70E-07	1.17E-08	1.91E-08	8.03E-08	1.12E-07	1.83E-07	7.70E-07	6.68E-07	1.10E-06	4.60E-06
Zinc	1.30E+02	2.64E+02	2.75E+03	1.12E-06	2.26E-06	2.36E-05	1.17E-07	2.36E-07	2.46E-06	1.12E-06	2.26E-06	2.36E-05	6.67E-06	1.35E-05	1.41E-04
Cyanide	1.02E+00	1.40E+00	1.40E+00	8.74E-09	1.20E-08	1.20E-08	9.12E-10	1.25E-09	1.25E-09	8.74E-09	1.20E-08	1.20E-08	5.22E-08	7.17E-08	7.17E-08
				DOSE = CS * RD * IR/BW CS = concentration in soil (mg/kg) RD = respirable dust (3.00E-08 kg/m3) IR = inhalation rate (20 m3/day) BW = body weight (70 kg)			DOSE = CS * RD * IR/BW CS = concentration in soil (mg/kg) RD = respirable dust (3.00E-08 kg/m3) IR = inhalation rate (20 m3/day * 2 hours/24 hours BW = body weight (55.9 kg)			DOSE = CS * RD * IR/BW CS = concentration in soil (mg/kg) RD = respirable dust (3.00E-08 kg/m3) IR = inhalation rate (20 m3/day) BW = body weight (70 kg)			DOSE = CS * RD * IR/BW CS = concentration in soil (mg/kg) RD = respirable dust (3.00E-08 kg/m3) IR = inhalation rate (25.6 m3/day) BW = body weight (15 kg)		

TABLE B-9. SOIL CONCENTRATIONS AND DERMAL DOSES FOR ALL RECEPTORS IN PRESENT AND FUTURE USE SCENARIOS

	SOIL CONCENTRATIONS			WORKER			TRESPASSER			ADULT			CHILD		
CHEMICAL	AVERAGE (mg/kg)	95% LIMIT (mg/kg)	MAXIMUM (mg/kg)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)
ORGANICS															
Acetone	1.09E-01	8.60E+01	8.60E+01	3.53E-06	2.78E-03	2.78E-03	4.42E-06	3.48E-03	3.48E-03	3.53E-06	2.78E-03	2.78E-03	2.06E-05	1.63E-02	1.63E-02
Aroclor 1254	4.19E-01	3.28E+00	1.80E+01	1.35E-06	1.06E-05	5.82E-05	1.70E-06	1.33E-05	7.28E-05	1.35E-06	1.06E-05	5.82E-05	7.92E-06	6.19E-05	3.40E-04
Benzene	3.43E-02	3.43E+01	3.43E+01	1.11E-06	1.11E-03	1.11E-03	1.39E-06	1.39E-03	1.39E-03	1.11E-06	1.11E-03	1.11E-03	6.48E-06	6.48E-03	6.48E-03
Bis(2-ethylhexyl)phthalate	1.37E+02	3.00E+04	3.00E+04	4.44E-04	9.69E-02	9.69E-02	5.56E-04	1.21E-01	1.21E-01	4.44E-04	9.69E-02	9.69E-02	2.60E-03	5.67E-01	5.67E-01
Butyl benzyl phthalate	1.95E-01	4.59E+00	1.40E+02	6.31E-07	1.48E-05	4.52E-04	7.90E-07	1.86E-05	5.67E-04	6.31E-07	1.48E-05	4.52E-04	3.69E-06	8.67E-05	2.65E-03
Di-n-butyl phthalate	2.21E-01	6.65E-01	3.00E+01	7.13E-07	2.15E-06	9.69E-05	8.93E-07	2.69E-06	1.21E-04	7.13E-07	2.15E-06	9.69E-05	4.17E-06	1.26E-05	5.67E-04
Di-n-octyl phthalate	5.27E-01	4.08E+00	5.90E+02	1.70E-06	1.32E-05	1.91E-03	2.13E-06	1.65E-05	2.39E-03	1.70E-06	1.32E-05	1.91E-03	9.97E-06	7.71E-05	1.12E-02
Ethylbenzene	1.27E-02	1.70E+03	1.70E+03	4.10E-07	5.49E-02	5.49E-02	5.13E-07	6.88E-02	6.88E-02	4.10E-07	5.49E-02	5.49E-02	2.40E-06	3.21E-01	3.21E-01
Methylene chloride	1.57E-01	3.10E+02	3.10E+02	5.06E-06	1.00E-02	1.00E-02	6.34E-06	1.25E-02	1.25E-02	5.06E-06	1.00E-02	1.00E-02	2.96E-05	5.86E-02	5.86E-02
Methyl ethyl ketone	3.24E-03	2.46E-01	9.50E+01	1.05E-07	7.95E-06	3.07E-03	1.31E-07	9.95E-06	3.84E-03	1.05E-07	7.95E-06	3.07E-03	6.13E-07	4.65E-05	1.80E-02
Polycyclic aromatic hydrocarbons (PAHs)															
Benzo(a)anthracene	9.72E-02	2.17E-01	2.70E+01	1.26E-07	2.80E-07	3.49E-05	1.57E-07	3.51E-07	4.37E-05	1.26E-07	2.80E-07	3.49E-05	7.35E-07	1.64E-06	2.04E-04
				5.28E-07	2.80E-07	3.49E-05	6.61E-07	3.50E-07	4.37E-05	5.28E-07	2.80E-07	3.49E-05	0.00E+00	0.00E+00	0.00E+00
Benzo(a)pyrene	8.62E-02	1.53E-01	2.30E+00	1.11E-07	1.98E-07	2.97E-06	1.40E-07	2.48E-07	3.72E-06	1.11E-07	1.98E-07	2.97E-06	6.52E-07	1.16E-06	1.74E-05
				1.87E-07	1.98E-07	2.97E-06	2.34E-07	2.48E-07	3.72E-06	1.87E-07	1.98E-07	2.97E-06	0.00E+00	0.00E+00	0.00E+00
Benzo(b)fluoranthene/Benzo(k)fluoranthene	1.29E-01	2.81E-01	1.60E+00	1.66E-07	3.63E-07	2.07E-06	2.08E-07	4.55E-07	2.59E-06	1.66E-07	3.63E-07	2.07E-06	9.73E-07	2.12E-06	1.21E-05
				3.07E-07	3.63E-07	2.07E-06	3.85E-07	4.54E-07	2.59E-06	3.07E-07	3.63E-07	2.07E-06	0.00E+00	0.00E+00	0.00E+00
Benzo(g,h,i)perylene	8.01E-02	1.42E-01	1.60E+00	1.04E-07	1.84E-07	2.07E-06	1.30E-07	2.30E-07	2.59E-06	1.04E-07	1.84E-07	2.07E-06	6.05E-07	1.07E-06	1.21E-05
Chrysene	9.58E-02	2.10E-01	2.60E+00	1.24E-07	2.71E-07	3.36E-06	1.55E-07	3.40E-07	4.21E-06	1.24E-07	2.71E-07	3.36E-06	7.24E-07	1.59E-06	1.97E-05
				2.43E-07	2.71E-07	3.36E-06	3.04E-07	3.39E-07	4.21E-06	2.43E-07	2.71E-07	3.36E-06	0.00E+00	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	4.37E-02	5.04E-02	9.50E-01	5.64E-08	6.51E-08	1.23E-06	7.07E-08	8.16E-08	1.54E-06	5.64E-08	6.51E-08	1.23E-06	3.30E-07	3.81E-07	7.18E-06
				6.85E-08	6.51E-08	1.23E-06	8.58E-08	8.16E-08	1.54E-06	6.85E-08	6.51E-08	1.23E-06	0.00E+00	0.00E+00	0.00E+00
Fluoranthene	5.65E-02	2.34E-01	4.40E+00	7.30E-08	3.02E-07	5.69E-06	9.14E-08	3.79E-07	7.12E-06	7.30E-08	3.02E-07	5.69E-06	4.27E-07	1.77E-06	3.33E-05
Indeno(1,2,3,c,d)pyrene	7.74E-02	1.21E-01	3.70E-01	1.00E-07	1.56E-07	4.78E-07	1.25E-07	1.96E-07	5.99E-07	1.00E-07	1.56E-07	4.78E-07	5.85E-07	9.15E-07	2.80E-06
				1.40E-07	1.57E-07	4.78E-07	1.76E-07	1.96E-07	5.99E-07	1.40E-07	1.57E-07	4.78E-07	0.00E+00	0.00E+00	0.00E+00
Phenanthrene	9.70E-02	2.77E-01	7.00E+00	1.25E-07	3.58E-07	9.05E-06	1.57E-07	4.48E-07	1.13E-05	1.25E-07	3.58E-07	9.05E-06	7.33E-07	2.09E-06	5.29E-05
Pyrene	1.05E-01	2.39E-01	3.90E+00	1.36E-07	3.09E-07	5.04E-06	1.70E-07	3.87E-07	6.31E-06	1.36E-07	3.09E-07	5.04E-06	7.94E-07	1.81E-06	2.95E-05
Tetrachloroethene	3.33E-03	3.72E-03	1.80E-02	1.08E-07	1.20E-07	5.82E-07	1.35E-07	1.51E-07	7.28E-07	1.08E-07	1.20E-07	5.82E-07	6.29E-07	7.03E-07	3.40E-06
Toluene	3.01E-03	1.03E-02	3.70E+01	9.74E-08	3.33E-07	1.20E-03	1.22E-07	4.17E-07	1.50E-03	9.74E-08	3.33E-07	1.20E-03	5.69E-07	1.95E-06	6.99E-03
Xylenes (total)	6.36E-02	7.40E+03	7.40E+03	2.05E-06	2.39E-01	2.39E-01	2.57E-06	2.99E-01	2.99E-01	2.05E-06	2.39E-01	2.39E-01	1.20E-05	1.40E+00	1.40E+00
INORGANICS															
Chromium (as Cr III)	1.80E+01	3.32E+01	4.31E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chromium (as Cr VI)	2.57E+00	4.74E+00	6.16E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

TABLE B-9. SOIL CONCENTRATIONS AND DERMAL DOSES FOR ALL RECEPTORS IN PRESENT AND FUTURE USE SCENARIOS

	SOIL CONCENTRATIONS			WORKER			TRESPASSER			ADULT			CHILD		
CHEMICAL	AVERAGE (mg/kg)	95% LIMIT (mg/kg)	MAXIMUM (mg/kg)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)	AVERAGE DOSE (mg/kg/day)	95% LIMIT DOSE (mg/kg/day)	MAXIMUM DOSE (mg/kg/day)
Copper	4.71E+01	8.85E+01	2.37E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nickel	1.31E+01	2.14E+01	8.98E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zinc	1.30E+02	2.64E+02	2.75E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cyanide	1.02E+00	1.40E+00	1.40E+00	3.29E-05	4.52E-05	4.52E-05	4.12E-05	5.67E-05	5.67E-05	3.29E-05	4.52E-05	4.52E-05	1.93E-04	2.65E-04	2.65E-04
				DOSE = CS*SA*AF*ABS/BW CS = concentration in soil (mg/kg) SA = surface area available for contact (3120 cm2/day) AF = adherence factor (1.45E-06 kg/cm2) ABS = absorption factor (PAHs - 2%, semivolatiles - 5%, volatile organics and cyanide - 50%, all other inorganics - 0%) BW = body weight (70 kg)			DOSE = CS*SA*AF*ABS/BW CS = concentration in soil (mg/kg) SA = surface area available for contact (3120 cm2/day) AF = adherence factor (1.45E-06 kg/cm2) ABS = absorption factor (PAHs - 2%, semivolatiles - 5%, volatile organics and cyanide - 50%, all other inorganics - 0%) BW = body weight (55.9 kg)			DOSE = CS*SA*AF*ABS/BW CS = concentration in soil (mg/kg) SA = surface area available for contact (3120 cm2/day) AF = adherence factor (1.45E-06 kg/cm2) ABS = absorption factor (PAHs - 2%, semivolatiles - 5%, volatile organics and cyanide - 50%, all other inorganics - 0%) BW = body weight (70 kg)			DOSE = CS*SA*AF*ABS/BW CS = concentration in soil (mg/kg) SA = surface area available for contact (3910 cm2/day) AF = adherence factor (1.45E-06 kg/cm2) ABS = absorption factor (PAHs - 2%, semivolatiles - 5%, volatile organics and cyanide - 50%, all other inorganics - 0%) BW = body weight (15 kg)		

TABLE B-10. STREAM SEDIMENT CONCENTRATIONS AND INGESTION DOSES FOR ALL RECEPTORS IN PRESENT AND FUTURE USE SCENARIOS - WADER/SWIMMER

CHEMICAL	SEDIMENT CONCENTRATIONS		DOSE	
	AVERAGE (mg/kg)	UPPER 95 (mg/kg)	AVERAGE (mg/kg/day)	UPPER 95 (mg/kg/day)
ORGANICS				
Bis(2-ethylhexyl)phthalate	6.27E+00	7.60E+01	6.27E-06	7.60E-05
Butyl benzyl phthalate	5.53E-01	9.20E-01	5.53E-07	9.20E-07
Di-n-butyl phthalate	3.30E-01	2.30E+00	3.30E-07	2.30E-06
Di-n-octyl phthalate	6.85E-01	2.10E+00	6.85E-07	2.10E-06
Methylene chloride	5.90E-02	5.90E-02	5.90E-08	5.90E-08
Methyl ethyl ketone	1.78E-02	5.30E-02	1.78E-08	5.30E-08
Naphthalene	2.51E-01	6.90E-01	2.51E-07	6.90E-07
Polyaromatic hydrocarbons (PAHs)				
Acenaphthene	3.28E-01	7.20E-01	3.28E-07	7.20E-07
Acenaphthylene	3.63E-01	4.90E-01	3.63E-07	4.90E-07
Anthracene	5.28E-01	2.60E+00	5.28E-07	2.60E-06
Benzo (a) anthracene	9.09E-01	6.40E+00	9.09E-07	6.40E-06
	9.09E-01	6.40E+00	9.09E-07	6.40E-06
Benzo(a)pyrene	8.16E-01	5.00E+00	8.16E-07	5.00E-06
	8.16E-01	5.00E+00	8.16E-07	5.00E-06
Benzo(b)fluoranthene/Benzo(k)fluoranthene	1.21E+00	8.20E+00	1.21E-06	8.20E-06
	1.21E+00	8.20E+00	1.21E-06	8.20E-06
Benzo(g,h,i)perylene	6.76E-01	3.30E+00	6.76E-07	3.30E-06
Chrysene	9.95E-01	6.50E+00	9.95E-07	6.50E-06
	9.95E-01	6.50E+00	9.95E-07	6.50E-06
Dibenzo(a,h)anthracene	3.38E-01	1.40E+00	3.38E-07	1.40E-06
	3.38E-01	1.40E+00	3.38E-07	1.40E-06
Fluoranthene	1.35E+00	1.40E+01	1.35E-06	1.40E-05
Fluorene	4.65E-01	9.78E-01	4.65E-07	9.78E-07
Indeno(1,2,3,c,d)pyrene	5.42E-01	2.50E+00	5.42E-07	2.50E-06
	5.42E-01	2.50E+00	5.42E-07	2.50E-06
2-Methylnaphthalene	2.00E-01	2.00E-01	2.00E-07	2.00E-07
Phenanthrene	1.17E+00	1.00E+01	1.17E-06	1.00E-05
Pyrene	1.30E+00	1.30E+01	1.30E-06	1.30E-05
Tetrachloroethene	3.56E-03	8.75E-03	3.56E-09	8.75E-09
Toluene	3.00E-03	3.00E-03	3.00E-09	3.00E-09
Xylenes (total)	3.00E-03	3.00E-03	3.00E-09	3.00E-09

TABLE B-10. STREAM SEDIMENT CONCENTRATIONS AND INGESTION DOSES FOR ALL RECEPTORS IN PRESENT AND FUTURE USE SCENARIOS - WADER/SWIMMER

CHEMICAL	SEDIMENT CONCENTRATIONS AVERAGE (mg/kg)	SEDIMENT CONCENTRATIONS UPPER 95 (mg/kg)	DOSE AVERAGE (mg/kg/day)	DOSE UPPER 95 (mg/kg/day)
INORGANICS				
Aluminum	2.91E+00	2.46E+03	2.91E-06	2.46E-03
Antimony	8.37E+00	4.30E+02	8.37E-06	4.30E-04
Arsenic	7.91E+00	1.19E+01	7.91E-06	1.19E-05
Barium	1.01E+00	1.04E+02	1.01E-06	1.04E-04
Cadmium	2.70E-01	5.00E+00	2.70E-07	5.00E-06
Calcium	2.38E+01	2.17E+03	2.38E-05	2.17E-03
Chromium (as Cr III)	2.77E+01	3.33E+01	2.77E-05	3.33E-05
Chromium (as Cr VI)	3.96E+00	4.76E+00	3.96E-06	4.76E-06
Cobalt	1.49E-01	5.27E+00	1.49E-07	5.27E-06
Copper	8.69E+01	3.92E+02	8.69E-05	3.92E-04
Iron	3.50E+00	1.71E+04	3.50E-06	1.71E-02
Lead	1.80E+02	6.55E+02	1.80E-04	6.55E-04
Magnesium	2.09E+01	1.47E+03	2.09E-05	1.47E-03
Manganese	2.66E-01	3.35E+02	2.66E-07	3.35E-04
Mercury	3.50E-01	2.50E+00	3.50E-07	2.50E-06
Nickel	1.73E+01	1.89E+01	1.73E-05	1.89E-05
Potassium	1.20E+01	2.75E+02	1.20E-05	2.75E-04
Sodium	9.56E+00	1.40E+02	9.56E-06	1.40E-04
Vanadium	4.29E-01	1.26E+02	4.29E-07	1.26E-04
Zinc	2.58E+02	5.47E+02	2.58E-04	5.47E-04

Dose = CSS * IR/BW
CSS = stream sediment concentration (mg/kg)
IR = Ingestion Rate (2.50E-05 kg/day)
BW = Body Weight (25 kg)

TABLE B-11. STREAM SEDIMENT CONCENTRATIONS AND DERMAL DOSES FOR ALL RECEPTORS IN PRESENT AND FUTURE USE SCENARIOS - WADER/SWIMMER

CHEMICAL	SEDIMENT CONCENTRATIONS		DOSE	
	AVERAGE (mg/kg)	UPPER 95 (mg/kg)	AVERAGE (mg/kg/day)	UPPER 95 (mg/kg/day)
ORGANICS				
Bis(2-ethylhexyl)phthalate	6.27E+00	7.60E+01	2.06E-05	2.50E-04
Butyl benzyl phthalate	5.53E-01	9.20E-01	1.82E-06	3.02E-06
Di-n-butyl phthalate	3.30E-01	2.30E+00	1.08E-06	7.56E-06
Di-n-octyl phthalate	6.85E-01	2.10E+00	2.25E-06	6.90E-06
Methylene chloride	5.90E-02	5.90E-02	1.94E-07	1.94E-07
Methyl ethyl ketone	1.78E-02	5.30E-02	5.86E-08	1.74E-07
Naphthalene	2.51E-01	6.90E-01	8.25E-07	2.27E-06
Polyaromatic hydrocarbons (PAHs)				
Acenaphthene	3.28E-01	7.20E-01	4.32E-07	9.46E-07
Acenaphthylene	3.63E-01	4.90E-01	4.78E-07	6.44E-07
Anthracene	5.28E-01	2.60E+00	6.94E-07	3.42E-06
Benzo (a) anthracene	9.09E-01	6.40E+00	1.19E-06	8.41E-06
	9.09E-01	6.40E+00	1.19E-06	8.41E-06
Benzo(a)pyrene	8.16E-01	5.00E+00	1.07E-06	6.57E-06
	8.16E-01	5.00E+00	1.07E-06	6.57E-06
Benzo(b)fluoranthene/Benzo(k)fluoranthene	1.21E+00	8.20E+00	1.59E-06	1.08E-05
	1.21E+00	8.20E+00	1.59E-06	1.08E-05
Benzo(g,h,i)perylene	6.76E-01	3.30E+00	8.88E-07	4.34E-06
Chrysene	9.95E-01	6.50E+00	1.31E-06	8.54E-06
	9.95E-01	6.50E+00	1.31E-06	8.54E-06
Dibenzo(a,h)anthracene	3.38E-01	1.40E+00	4.44E-07	1.84E-06
	3.38E-01	1.40E+00	4.44E-07	1.84E-06
Fluoranthene	1.35E+00	1.40E+01	1.78E-06	1.84E-05
Fluorene	4.65E-01	9.78E-01	6.11E-07	1.28E-06
Indeno(1,2,3,c,d)pyrene	5.42E-01	2.50E+00	7.12E-07	3.28E-06
	5.42E-01	2.50E+00	7.12E-07	3.28E-06
2-Methylnaphthalene	2.00E-01	2.00E-01	2.63E-07	2.63E-07
Phenanthrene	1.17E+00	1.00E+01	1.53E-06	1.31E-05
Pyrene	1.30E+00	1.30E+01	1.71E-06	1.71E-05
Tetrachloroethene	3.56E-03	8.75E-03	1.17E-07	2.87E-07
Toluene	3.00E-03	3.00E-03	9.85E-08	9.85E-08
Xylenes (total)	3.00E-03	3.00E-03	9.85E-08	9.85E-08

TABLE B-11. STREAM SEDIMENT CONCENTRATIONS AND DERMAL DOSES FOR ALL RECEPTORS IN PRESENT AND FUTURE USE SCENARIOS - WADER/SWIMMER

	SEDIMENT CONCENTRATIONS		DOSE	
CHEMICAL	AVERAGE (mg/kg)	UPPER 95 (mg/kg)	AVERAGE (mg/kg/day)	UPPER 95 (mg/kg/day)
INORGANICS				
Aluminum	2.91E+00	2.46E+03	0.00E+00	0.00E+00
Antimony	8.37E+00	4.30E+02	0.00E+00	0.00E+00
Arsenic	7.91E+00	1.19E+01	0.00E+00	0.00E+00
Barium	1.01E+00	1.04E+02	0.00E+00	0.00E+00
Cadmium	2.70E-01	5.00E+00	0.00E+00	0.00E+00
Calcium	2.38E+01	2.17E+03	0.00E+00	0.00E+00
Chromium (as Cr III)	2.77E+01	3.33E+01	0.00E+00	0.00E+00
Chromium (as Cr VI)	3.96E+00	4.76E+00	0.00E+00	0.00E+00
Cobalt	1.49E-01	5.27E+00	0.00E+00	0.00E+00
Copper	8.69E+01	3.92E+02	0.00E+00	0.00E+00
Iron	3.50E+00	1.71E+04	0.00E+00	0.00E+00
Lead	1.80E+02	6.55E+02	0.00E+00	0.00E+00
Magnesium	2.09E+01	1.47E+03	0.00E+00	0.00E+00
Manganese	2.66E-01	3.35E+02	0.00E+00	0.00E+00
Mercury	3.50E-01	2.50E+00	0.00E+00	0.00E+00
Nickel	1.73E+01	1.89E+01	0.00E+00	0.00E+00
Potassium	1.20E+01	2.75E+02	0.00E+00	0.00E+00
Sodium	9.56E+00	1.40E+02	0.00E+00	0.00E+00
Vanadium	4.29E-01	1.26E+02	0.00E+00	0.00E+00
Zinc	2.58E+02	5.47E+02	0.00E+00	0.00E+00

DOSE = CSS*SA*AF*ABS/BW
CSS = stream sediment concentration (mg/kg)
SA = surface area available for contact (1132.7 cm2/day)
AF = adherence factor (1.45E-06 kg/cm2)
ABS = absorbance factor (PAHs - 2%, semivolatile organics - 5%, volatile organics and cyanide - 50%, other inorganics - 0%)
BW = body weight (25 kg)

TABLE B-12. SURFACE WATER CONCENTRATIONS AND INGESTION DOSES FOR ALL RECEPTORS IN PRESENT AND FUTURE USE SCENARIOS - WADER/SWIMMER

CHEMICAL	SURFACE WATER CONCENTRATIONS AVERAGE (mg/L)	SURFACE WATER CONCENTRATIONS UPPER 95 (mg/L)	INGESTION DOSE AVERAGE (mg/kg/day)	INGESTION DOSE UPPER 95 (mg/kg/day)
INORGANICS				
Arsenic	2.42E-03	2.45E-03	4.83E-06	4.90E-06
Barium	4.83E-02	1.00E-01	9.67E-05	2.00E-04
Calcium	4.75E+00	1.71E+01	9.49E-03	3.42E-02
Chromium (as Cr III)	3.64E-03	7.00E-03	7.28E-06	1.40E-05
Chromium (as Cr IV)	5.20E-04	1.00E-03	1.04E-06	2.00E-06
Iron	9.16E-02	3.07E-01	1.83E-04	6.14E-04
Magnesium	3.52E+00	6.98E+00	7.04E-03	1.40E-02
Manganese	1.36E-02	4.49E-02	2.72E-05	8.98E-05
Selenium	2.20E-03	2.50E-03	4.40E-06	5.00E-06
Sodium	4.47E+00	1.43E+01	8.94E-03	2.86E-02
Vanadium	1.76E-02	2.50E-02	3.52E-05	5.00E-05
			Dose = CSW * CR * ET/BW	
			CSW = surface water concentration (mg/L)	
			CR = contact rate (0.05 L/hour)	
			ET = exposure time (1 hour/event, 1 event/day)	
			BW = body weight (25 kg)	

TABLE B-13. SURFACE WATER CONCENTRATIONS AND DERMAL CONTACT DOSES FOR ALL RECEPTORS IN PRESENT AND FUTURE USE SCENARIOS - WADER/SWIMMER

	SURFACE WATER CONCENTRATIONS		DERMAL DOSE	
CHEMICAL	AVERAGE (mg/L)	UPPER 95 (mg/L)	AVERAGE (mg/kg/day)	UPPER 95 (mg/kg/day)
INORGANICS				
Arsenic	2.42E-03	2.45E-03	7.15E-07	7.25E-07
Barium	4.83E-02	1.00E-01	1.43E-05	2.96E-05
Calcium	4.75E+00	1.71E+01	1.40E-03	5.06E-03
Chromium (as Cr III)	3.64E-03	7.00E-03	1.08E-06	2.07E-06
Chromium (as Cr IV)	5.20E-04	1.00E-03	1.54E-07	2.96E-07
Iron	9.16E-02	3.07E-01	2.71E-05	9.09E-05
Magnesium	3.52E+00	6.98E+00	1.04E-03	2.07E-03
Manganese	1.36E-02	4.49E-02	4.03E-06	1.33E-05
Selenium	2.20E-03	2.50E-03	6.51E-07	7.40E-07
Sodium	4.47E+00	1.43E+01	1.32E-03	4.23E-03
Vanadium	1.76E-02	2.50E-02	5.21E-06	7.40E-06

Dose = CSW * SA * PC * ET * CF/BW
CSW = surface water concentration (mg/L)
SA = surface area available for contact (9250 cm2)
PC = dermal permeability constant (8.00E-04 cm/hour)
ET = exposure time (1 hour/day)
CF = volumetric conversion factor (1 L/1000 cm3)
BW = body weight (25 kg)

TABLE B-14. SURFACE WATER CONCENTRATIONS AND FISH INGESTION DOSES FOR ALL RECEPTORS IN PRESENT AND FUTURE USE SCENARIOS - ADULT AND CHILD

	SURFACE WATER CONCENTRATION			CHILD		ADULT	
CHEMICAL	AVERAGE (mg/L)	UPPER95 (mg/L)	BCF (L/kg)	AVERAGE DOSE (mg/kg day)	UPPER95 DOSE (mg/kg day)	AVERAGE DOSE (mg/kg day)	UPPER95 DOSE (mg/kg day)
INORGANICS							
Arsenic	2.42E-03	2.45E-03	350	1.52E-03	1.54E-03	6.52E-04	6.61E-04
Barium	4.83E-02	1.00E-01	NA	NA	NA	NA	NA
Calcium	4.75E+00	1.71E+01	NA	NA	NA	NA	NA
Chromium (as Cr III)	3.64E-03	7.00E-03	127	8.32E-04	1.60E-03	3.57E-04	6.86E-04
Chromium (as Cr IV)	5.20E-04	1.00E-03	154	1.44E-04	2.77E-04	6.18E-05	1.19E-04
Iron	9.16E-02	3.07E-01	NA	NA	NA	NA	NA
Magnesium	3.52E+00	6.98E+00	NA	NA	NA	NA	NA
Manganese	1.36E-02	4.49E-02	NA	NA	NA	NA	NA
Selenium	2.20E-03	2.50E-03	16	6.33E-05	7.20E-05	2.71E-05	3.09E-05
Sodium	4.47E+00	1.43E+01	NA	NA	NA	NA	NA
Vanadium	1.76E-02	2.50E-02	NA	NA	NA	NA	NA
				Dose = CSW*BCF*IR/BW/CF CSW = concentration in surface water (mg/L) BCF = bioconcentration factor IR = ingestion rate (27 g/day) BW = body weight (15 kg) CF = conversion factor (1000 g/kg) NA = not applicable		Dose = CSW*BCF*IR/BW/CF CSW = concentration in surface water (mg/L) BCF = bioconcentration factor IR = ingestion rate (54 g/day) BW = body weight (70 kg) CF = conversion factor (1000 g/kg) NA = not applicable

APPENDIX C
DERIVATION OF SELECTED ORAL REFERENCE DOSES

APPENDIX C
DERIVATION OF SELECTED ORAL REFERENCE DOSES

C.1 CHRONIC REFERENCE DOSES

C.1.1 Derivation from Toxicity-Based Values/Standards

A chronic oral RfD for 1,2-dichloroethane was derived from an adjusted acceptable daily intake (AADI) of 0.260 mg/L (EPA, 1984). Although there is a more currently developed MCL for 1,2-dichloroethane, the MCL is based on carcinogenic effects (EPA, 1987) and, therefore, is not suitable for the derivation of an RfD. The AADI was calculated by EPA from an inhalation no-observed-adverse-effect level (NOAEL) for which the toxic endpoints included growth rate, organ function, blood chemistry, behavior, mortality, and general appearance (EPA, 1984). A chronic oral RfD of 7.40E-03 mg/kg/day was derived for 1,2-dichloroethane from the AADI, by assuming the consumption of 2 liters of water/day and a body weight of 70 kg (EPA, 1989).

C.1.2 Derivation from Toxicity Data

Chronic oral RfDs were derived for benzene and aluminum according to U.S. EPA guidelines (EPA, 1989). The RfD for benzene was based on a NOAEL of 1 mg/kg/day from a 26-week study in rats, in which leucopenia and erythrocytopenia were the toxic endpoints (Wolf et al., 1956). Applying uncertainty factors of 10 each for extrapolating from a subchronic to a chronic exposure, for extrapolating from animals to humans, and for human variation, a chronic RfD of 1.00E-03 mg/kg/day was derived.

A chronic oral RfD of 1.93E-02 mg/kg/day was calculated for aluminum. The RfD was derived from data from a multigenerational (180-390 day) study in mice in which aluminum (as aluminum chloride) was administered in the drinking water (Ondreicka et al., 1966). At a dose of 19.3 mg/kg/day, marked growth retardation was observed in the second and subsequent litters from the second generation and in all letters from the third generation.

Using 19.3 mg/kg/day as a LOAEL, uncertainty factors of 10 each were applied for extrapolating from a LOAEL to a NOAEL, for extrapolating from animals to humans, and for human variation.

C.1.3 Derivation from Oral Lethality Data

In the absence of chronic toxicity data and toxicity-based values/standards, chronic oral RfDs were derived for several of the organic contaminants based on acute oral toxicity data for these chemicals or their isomers. Either the lowest reported lethal oral dose (LD_{LO}) or the lowest reported oral dose that is lethal to 50 percent of the test animals (LD_{50}) was used. The chronic RfD was arrived at by applying an uncertainty factor of 100,000 to the LD_{LO} or LD_{50} in accordance with the approach developed by Layton et al. (1987). The chronic oral RfDs that were derived using this method are presented in Table B-1.

C.1.4 Derivation from Nutritional Information

A number of the chemicals of concern are essential dietary elements. In the absence of sufficient toxicity data from which to derive oral RfDs for these chemicals, RfDs were derived from information regarding recommended or normal dietary intakes (i.e., dosages which are considered to be safe). Dietary requirements and intakes, expressed in mg/day, were converted to RfDs by dividing by a body weight of 70 kg.

Table C-1
Chronic Oral Reference Doses (RfDs) Derived From
Lethal Toxicity Data

Chemical	LD_{50} or LD_{LO} (a) (mg/kg)	Test Species	Chronic Oral RfD (mg/kg/day)
1-Ethyl-3-methylbenzene	LD_{LO} 5,000 (b)	rat	5.00E-02
1,2-Diethylbenzene	LD_{LO} 5,000	rat	5.00E-02
n-Butylbenzene	LD_{LO} 5,000	rat	5.00E-02
1,2,3,4-Tetramethylbenzene	LD_{50} 6,408	rat	6.40E-02
1,2,3/1,2,4-Trimethylbenzene	LD_{LO} 5,000 (c)	rat	5.00E-02

(a) Reference: RTECS, 1990
(b) Value is for 1-ethyl-2-methylbenzene and 1-ethyl-4-methylbenzene
(c) Value is for 1,2,3-trimethylbenzene

Chronic oral RfDs of 1.14E+00 mg/kg/day for calcium, 2.57E-01 mg/kg/day for iron, and 5.70E+00 mg/kg/day for manganese were based on maximum recommended dietary allowances of 800 mg/day, 18 mg/day, and 400 mg/day, respectively. Chronic oral RfDs of 8.00E+01 mg/kg/day for potassium and 4.70E-01 mg/kg/day for sodium were calculated from respective estimated adequate and safe daily intakes of 5,600 mg/day and 3,300 mg/day (NAS, 1980). For cobalt, a chronic oral RfD of 2.30E-03 mg/kg/day was derived from a reported normal maximum daily intake of 0.160 mg/day. This level is known to be without adverse effects (Osol, 1980).

C.1.5 Other Derivations

Neither short-term toxicity data, chronic oral toxicity data, nor toxicity-based values/standards could be found for 1,3,5-trimethylbenzene or n-decane. Options for values that could be used as the chronic oral RfD for 1,3,5-trimethylbenzene included the chronic oral RfD that was derived for 1,2,3/1,2,4-trimethylbenzene (5.00E-02 mg/kg/day), or the inhalation RfD that was derived for 1,3,5-trimethylbenzene from its TLV-TWA (1.26E-01 mg/kg/day) (see Subsection 4.3.2). The more conservative of the values, 5.00E-02 mg/kg/day was selected to be used as the chronic oral RfD for 1,3,5-trimethylbenzene.

There were no EPA-derived RfDs for compounds that are closely chemically related to n-decane (i.e., nonane, octane). Occupational exposure limits were also unavailable for n-decane. The chronic oral RfD for n-decane was developed by using the chronic inhalation RfD that was derived for n-nonane from its ACGIH-TWA (see Subsection 4.3.2). Applying a modifying factor of 5 to the TWA of 1.07E+00 mg/kg/day to account for possible differences in toxicity between the two chemicals, a chronic oral RfD of 2.10E-01 mg/kg/day was calculated.

C.2 SUBCHRONIC REFERENCE DOSES

A subchronic RfD was derived for only one chemical, benzene. The RfD was based on a NOAEL of 1 mg/kg/day from a 26-day feeding study in rats in which leukocytopenia and erythrocytopenia were the toxic endpoints (Wolf et al., 1956). Applying uncertainty factors of 10 each for extrapolating from animals to humans and for human variation, a subchronic RfD of 1.00E-02 mg/kg/day was calculated.

C.3 REFERENCES

ATSDR (Agency for Toxic Substances and Disease Registry), 1989. *Toxicological Profile for Benzene*. Prepared by Oak Ridge National Laboratory for ATSDR and U.S. EPA. PB89-209464.

EPA (U.S. Environmental Protection Agency), 1984. National Primary Drinking Water Regulations; Volatile Synthetic Organic Chemicals. 40 CFR Part 141. *Fed. Reg.* 49 (114):24330.

EPA (U.S. Environmental Protection Agency), 1987. National Primary Drinking Water Regulations; Synthetic Organic Chemicals; Monitoring for Unregulated Contaminants. 40 CFR Parts 141 and 142. *Fed Reg.* 52 (130):25690.

EPA (U.S. Environmental Protection Agency), 1988. Drinking Water Regulations; Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper. 40 CFR Parts 141 and 142. *Fed. Reg.* 53 (160):31516.

EPA (U.S. Environmental Protection Agency), 1989. *Risk Assessment Guidance for Superfund. Human Health Evaluation Manual - Part A*. Interim Final. Office of Solid Waste and Emergency Response. Washington, DC. OSWER Directive 9285.7-01a.

Layton, D.W., Mallon, B.J., Rosenblatt, D.H., and M.J. Small, 1987. Deriving allowable daily intakes for systemic toxicants lacking chronic toxicity data. *Reg. Toxicol. Pharmacol.* 7:96.

NAS (National Academy of Sciences), 1980. *Drinking Water and Health*, Volume 3. National Academy Press., Washington, DC.

Ondreicka, R., Ginter, E., and J. Kortus, 1966. Chronic toxicity of aluminum in rats and mice and its effects on phosphorus metabolism. *Brit. J. Industr. Med.* 23:305.

Osol, A. 1980. *Remington's Pharmaceutical Sciences*, 16th edition. Mack Publishing Co. Easton, PA.

RTECS (Registry of Toxic Effects of Chemical Substances), 1990. Microfiche. National Institute for Occupational Safety and Health (NIOSH). April 1990.

Wolf, M.A., Rowe, V.K., McCollister, D.D., Hollingsworth, R.L., and F. Oyen, 1956. Toxicological studies of certain alkylated benzenes and benzene. *AMA Arch. Ind. Health* 14:387. (cited in ATSDR, 1989).

APPENDIX D
HOT SPOT ANALYSIS

APPENDIX D
HOT SPOT ANALYSIS

This "hot spot" analysis has been completed as per NJDEP guidance for use as a tool to direct and prioritize remediation at the L.E. Carpenter site.

Included in this analysis are locations from groundwater and soils (both test pit and hand auger) sampling. Stream sediments and surface water data were not considered for the analysis because of limitations in sample sizes and the inability to isolate specific areas for characterization.

The "hot spot" analysis involved the determination of the presence of areas on the site where contaminants of concern (see Table 2-9 of the main text) were elevated above the site average concentration.

The flag of an elevated concentration is placed upon any chemical that, in a particular media specific delineated site area, is greater than 10 times the overall site average.

The data suggest that no "hot spots" appear in the groundwater media. There is limited evidence for soil "hot spots" as previously defined. Elevations in two phthalate esters and one PAH in areas of the site are as follows:

Benzo(a)anthracene -	16.9x overall site average in soil taken from the Building 13 loading dock area.
Di-n-butyl phthalate -	28.6x overall site average in soil around the discharge of floor drain site outside Building 13.
Di-n-octyl phthalate -	11.9x overall site average in soil around the pollution control tanks east of Building 14.

Since only three compounds were found at elevated levels, all at different places on-site it is considered that these data points more arguably represent data outliers rather than true hot spots. Therefore it was not deemed necessary to carry the "hot spot" data through a baseline risk assessment. The overall site maximum presented in the baseline risk assessment portrays the "worst-case" situation.

The three areas with an elevated contaminant concentration were presented here for remedial considerations, to be used at a later date. The following tabular information represents the hot spot analysis.

TABLE D-1. AVERAGE AIR CONCENTRATIONS - OVERALL SITE AND INDIVIDUAL SAMPLES

CHEMICAL	SITE AVERAGE (mg/m3)	SAMPLE 2 AVERAGE (mg/m3)	SAMPLE 3 AVERAGE (mg/m3)	SAMPLE 4 AVERAGE (mg/m3)
ORGANICS				
Acetone	6.23E-02	1.57E-02	1.65E-02	1.55E-01
INORGANICS				
Cadmium	5.67E-04	1.00E-03	4.00E-04	3.00E-04
Lead	4.29E-03	1.10E-02	1.60E-03	3.00E-04
Zinc	1.74E-02	4.02E-02	5.62E-03	6.39E-03

TABLE D-2 AVERAGE SHALLOW GROUNDWATER CONCENTRATIONS - OVERALL SITE AND INDIVIDUAL WELLS

CHEMICAL	SITE AVERAGE (mg/L)	MW-1 AVERAGE (mg/L)	MW-2 AVERAGE (mg/L)	MW-3 AVERAGE (mg/L)	MW-4 AVERAGE (mg/L)	MW-5 AVERAGE (mg/L)	MW-6 AVERAGE (mg/L)	MW-7 AVERAGE (mg/L)	MW-8 AVERAGE (mg/L)	MW-9 AVERAGE (mg/L)	MW-10 AVERAGE (mg/L)	MW-12s AVERAGE (mg/L)	MW-13s AVERAGE (mg/L)	MW-14s AVERAGE (mg/L)	MW-15s AVERAGE (mg/L)	MW-16s AVERAGE (mg/L)	MW-17s AVERAGE (mg/L)	MW-18s AVERAGE (mg/L)
ORGANICS																		
Bis(2-ethylhexyl)phthalate	7.26E+00	3.85E-02	2.75E-02	1.90E+01	2.75E-02	3.00E-02	6.20E+01	4.10E+00	8.20E-01	4.80E-02	3.40E+01	2.81E+00	5.00E-03	3.98E-01	5.00E-03	5.00E-03	5.00E-03	5.50E-03
Butyl benzyl phthalate	5.48E-02	1.92E-02	1.92E-02	2.95E-01	5.00E-03	2.38E-02	1.60E-01	5.00E-03	1.25E-02	5.00E-03	3.50E-01	5.00E-03	5.00E-03	5.50E-03	5.00E-03	5.00E-03	5.00E-03	5.50E-03
1,1-Dichloroethane	2.75E-02	0.00E+00	1.25E-02	0.00E+00	2.50E-03	2.50E-03	0.00E+00	2.50E-01	2.50E-03	2.50E-03	0.00E+00	5.00E-02	2.20E-02	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03
1,1-Dichloroethene	3.34E-03	4.10E-03	4.10E-03	4.10E-03	2.50E-03	2.50E-03	4.60E-03	4.60E-03	2.50E-03	2.50E-03	4.60E-03	4.10E-03	4.10E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03
1,2-Dichloroethene (total)	6.96E-03	0.00E+00	2.50E-02	0.00E+00	2.50E-03	2.50E-03	0.00E+00	0.00E+00	2.50E-03	2.50E-03	0.00E+00	2.50E-02	1.10E-02	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03
1,2-diethylbenzene	1.58E-02	1.50E-02	6.80E-03	2.10E-02	5.00E-03	2.38E-02	1.00E-01	2.80E-02	1.25E-02	5.00E-03	1.30E-02	5.00E-03	5.00E-03	5.50E-03	5.00E-03	5.00E-03	5.00E-03	5.50E-03
2,4-Dimethylphenol	3.06E-02	1.94E-01	1.81E-02	1.50E-02	9.90E-03	2.26E-02	1.80E-01	4.10E-03	1.14E-02	2.80E-03	8.60E-02	1.74E-02	3.90E-03	4.40E-03	3.90E-03	3.90E-03	3.90E-03	4.40E-03
Di-n-butyl phthalate	2.06E-02	1.92E-02	1.92E-02	1.10E-01	5.00E-03	2.38E-02	5.00E-03	5.00E-03	1.25E-02	5.00E-03	1.20E-02	1.02E-01	5.00E-03	5.50E-03	5.00E-03	5.00E-03	5.00E-03	5.50E-03
Di-n-octyl phthalate	5.36E-02	1.81E-02	1.81E-02	5.35E-01	3.90E-03	2.26E-02	1.20E-01	3.20E-02	1.14E-02	2.80E-03	8.90E-02	3.30E-02	3.90E-03	4.40E-03	3.90E-03	3.90E-03	3.90E-03	4.40E-03
Ethylbenzene	3.59E+00	6.85E+00	5.15E-02	8.45E+00	2.10E-03	2.10E-03	1.60E+01	3.30E+00	1.79E-02	2.50E-03	2.60E+01	3.40E-01	2.10E-03	2.10E-03	2.10E-03	2.10E-03	2.10E-03	2.10E-03
1-Ethyl-3-methylbenzene	7.24E-02	1.47E-01	2.72E-02	2.70E-01	3.65E-03	2.24E-02	4.20E-01	1.10E-01	1.50E-02	2.30E-03	1.80E-01	1.02E-02	3.65E-03	4.15E-03	3.65E-03	3.65E-03	3.65E-03	4.15E-03
Isopropyl benzene	2.37E-02	2.45E-02	2.90E-02	5.05E-02	5.00E-03	1.10E-02	1.00E-01	4.80E-02	1.40E-02	5.00E-03	6.00E-02	5.00E-03	5.00E-03	5.50E-03	5.00E-03	5.00E-03	5.00E-03	5.50E-03
Methylene chloride	1.68E-01	3.50E-01	1.40E-01	9.70E-01	1.25E-02	7.50E-03	3.80E-01	3.80E-01	7.00E-02	0.00E+00	0.00E+00	1.95E-01	2.50E-03	7.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03
Naphthalene	2.53E-03	2.45E-03	2.45E-03	2.45E-03	2.45E-03	2.45E-03	2.70E-03	2.70E-03	2.45E-03	2.70E-03	2.70E-03	2.85E-03	2.45E-03	2.45E-03	2.45E-03	2.45E-03	2.45E-03	2.45E-03
n-Butylbenzene	6.08E-03	6.00E-03	5.00E-03	2.40E-02	5.00E-03	5.00E-03	5.00E-03	6.80E-03	1.25E-02	5.00E-03	2.70E-02	5.00E-03	5.00E-03	5.50E-03	5.00E-03	5.00E-03	5.00E-03	5.50E-03
n-Decane	4.67E-01	1.99E-02	1.92E-02	2.60E+00	5.00E-03	2.38E-02	3.10E+00	4.70E-02	1.80E-02	5.00E-03	2.40E+00	5.95E-03	5.00E-03	5.50E-03	5.00E-03	5.00E-03	5.00E-03	5.50E-03
n-Nonane	8.15E-02	2.17E-02	1.92E-02	7.05E-01	5.00E-03	2.38E-02	5.20E-01	3.30E-02	1.25E-02	5.00E-03	5.00E-03	5.00E-03	5.00E-03	5.50E-03	5.00E-03	5.00E-03	5.00E-03	5.50E-03
Phenol	2.24E-02	8.18E-02	1.92E-02	5.00E-03	5.00E-03	2.38E-02	6.80E-02	5.00E-03	1.25E-02	5.00E-03	1.20E-01	5.00E-03	5.00E-03	5.50E-03	5.00E-03	5.00E-03	5.00E-03	5.50E-03
Tetrachloroethene	3.20E-03	3.85E-03	3.85E-03	3.85E-03	2.50E-03	2.50E-03	4.20E-03	4.20E-03	2.50E-03	2.50E-03	4.20E-03	3.85E-03	3.85E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03
1,2,3,4-Tetramethylbenzene	1.47E-02	1.89E-02	1.89E-02	7.20E-03	4.70E-03	2.34E-02	4.40E-03	4.40E-03	1.22E-02	4.40E-03	4.40E-03	1.17E-01	4.70E-03	5.20E-03	4.70E-03	4.70E-03	4.70E-03	5.20E-03
Toluene	3.37E-02	8.85E-02	1.31E-02	5.55E-02	1.80E-03	1.80E-03	1.10E-01	1.10E-01	1.80E-03	2.50E-03	1.10E-01	6.65E-02	1.80E-03	1.80E-03	1.80E-03	1.80E-03	1.80E-03	1.80E-03
1,1,1-Trichloroethane	2.84E-03	3.05E-03	3.05E-03	3.05E-03	2.50E-03	2.50E-03	3.50E-03	3.50E-03	2.50E-03	2.50E-03	3.50E-03	3.05E-03	3.05E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03
Trichloroethene	3.42E-03	4.40E-03	4.40E-03	4.40E-03	2.50E-03	2.50E-03	4.40E-03	4.40E-03	2.50E-03	2.50E-03	4.40E-03	4.40E-03	4.80E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.80E-03
1,2,3-Trimethylbenzene/1,2,4-Trimethylbenzene	9.81E-02	1.55E-01	5.25E-02	4.57E-01	1.00E-02	4.75E-02	3.20E-01	1.10E-01	2.50E-02	1.00E-02	2.40E-01	1.79E-01	1.00E-02	1.10E-02	1.00E-02	1.00E-02	1.00E-02	1.10E-02
1,3,5-Trimethylbenzene	1.05E-01	2.80E-01	1.92E-02	3.05E-01	5.00E-03	2.38E-02	4.90E-01	1.10E-01	1.32E-02	5.00E-03	4.90E-01	1.55E-02	5.00E-03	5.50E-03	5.00E-03	5.00E-03	5.00E-03	5.50E-03
Xylenes (Total)	2.08E+01	3.40E+01	1.45E+00	4.90E+01	9.75E-03	2.50E-03	1.20E+02	1.50E+01	2.57E-02	2.50E-03	1.20E+02	1.46E+01	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03

TABLE D-2 AVERAGE SHALLOW GROUNDWATER CONCENTRATIONS - OVERALL SITE AND INDIVIDUAL WELLS (continued)

CHEMICAL	SITE AVERAGE (mg/L)	MW-1 AVERAGE (mg/L)	MW-2 AVERAGE (mg/L)	MW-3 AVERAGE (mg/L)	MW-4 AVERAGE (mg/L)	MW-5 AVERAGE (mg/L)	MW-6 AVERAGE (mg/L)	MW-7 AVERAGE (mg/L)	MW-8 AVERAGE (mg/L)	MW-9 AVERAGE (mg/L)	MW-10 AVERAGE (mg/L)	MW-12s AVERAGE (mg/L)	MW-13s AVERAGE (mg/L)	MW-14s AVERAGE (mg/L)	MW-15s AVERAGE (mg/L)	MW-16s AVERAGE (mg/L)	MW-17s AVERAGE (mg/L)	MW-18s AVERAGE (mg/L)
INORGANICS																		
Antimony	1.69E-01	1.92E-01	1.70E-01	2.84E-01	2.88E-02	2.90E-01	5.49E-01	3.00E-02	2.88E-01	3.12E-02	3.55E-01	3.00E-02	2.88E-02	2.88E-02	2.88E-02	3.06E-02	6.27E-02	4.82E-01
Arsenic	1.02E-02	1.20E-02	5.75E-03	5.80E-03	2.95E-03	3.20E-03	3.30E-03	3.17E-02	3.05E-03	3.10E-03	2.13E-02	1.93E-02	1.72E-02	4.83E-03	5.45E-03	3.10E-03	5.04E-03	2.65E-02
Copper	1.80E-02	7.32E-03	7.32E-03	7.32E-03	6.32E-02	8.91E-02	8.10E-03	2.61E-02	7.32E-03	8.10E-03	8.10E-03	1.71E-02	1.63E-02	7.32E-03	6.55E-03	6.55E-03	1.13E-02	8.10E-03
Nickel	2.21E-02	5.07E-03	3.25E-02	5.00E-02	6.43E-02	7.01E-02	1.00E-04	1.00E-04	5.07E-03	1.00E-04	1.00E-04	1.00E-02	5.07E-03	1.50E-02	2.00E-02	2.01E-02	9.13E-03	7.01E-02
Selenium	3.19E-03	2.13E-03	5.50E-03	8.63E-03	2.38E-03	2.25E-03	2.00E-03	2.00E-03	2.13E-03	2.00E-03	2.00E-03	2.25E-03	2.13E-03	2.38E-03	2.38E-03	2.25E-03	2.35E-03	8.50E-03
Zinc	9.23E-02	1.00E-01	1.86E-01	1.18E-01	1.04E-01	5.82E-02	5.64E-02	2.24E-01	1.56E-02	1.00E-02	4.63E-02	1.33E-01	1.17E-01	1.00E-02	1.20E-01	1.20E-01	1.04E-01	4.63E-02

TABLE D-3 AVERAGE INTERMEDIATE GROUNDWATER CONCENTRATIONS - OVERALL SITE AND INDIVIDUAL WELLS

CHEMICAL	SITE AVERAGE (mg/L)	MW-11I AVERAGE (mg/L)	MW-12I AVERAGE (mg/L)	MW-13I AVERAGE (mg/L)	MW-14I AVERAGE (mg/L)	MW-15I AVERAGE (mg/L)	MW-16I AVERAGE (mg/L)	MW-18I AVERAGE (mg/L)
ORGANICS								
Bis(2-ethylhexyl)phthalate	9.45E-03	3.70E-03	4.10E-02	7.45E-03	3.70E-03	3.70E-03	2.40E-03	4.20E-03
2,4-Dimethylphenol	1.07E-02	4.06E-02	5.00E-03	8.75E-03	5.00E-03	5.00E-03	5.00E-03	5.50E-03
Ethylbenzene	8.61E-03	4.52E-02	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03
Xylenes (Total)	5.30E-02	3.56E-01	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03
INORGANICS								
Arsenic	1.01E+00	2.69E-02	6.13E-03	2.75E-02	1.66E-02	7.00E+00	3.35E-03	1.31E-02
Chromium III	8.22E+00	4.50E-03	7.84E-03	4.46E-02	2.60E-02	6.30E+00	2.25E-03	2.25E-03
Chromium VI	9.13E-01	5.00E-04	8.71E-04	4.95E-03	2.89E-03	7.00E-01	2.50E-04	2.50E-04
Copper	8.67E-01	1.00E-02	2.00E-02	1.31E-02	1.10E-02	6.00E+00	3.65E-03	5.00E-03
Nickel	1.34E+00	6.35E-01	9.44E-02	6.35E-01	4.10E-01	7.03E+00	4.06E-02	5.10E-01
Selenium	1.00E+00	2.45E-03	2.46E-03	2.45E-03	2.50E-03	7.00E+00	1.25E-03	1.20E-03
Zinc	1.38E+00	4.40E-01	1.03E-01	4.40E-01	2.25E-01	8.00E+00	0.00E+00	4.40E-01

TABLE D-4 AVERAGE DEEP GROUNDWATER CONCENTRATIONS - OVERALL SITE AND INDIVIDUAL WELLS

CHEMICAL	SITE AVERAGE (mg/L)	MW-11I AVERAGE (mg/L)	MW-12I AVERAGE (mg/L)	MW-13I AVERAGE (mg/L)	MW-14I AVERAGE (mg/L)	MW-15I AVERAGE (mg/L)	MW-16I AVERAGE (mg/L)	MW-18I AVERAGE (mg/L)
ORGANICS								
Bis(2-ethylhexyl)phthalate	9.45E-03	3.70E-03	4.10E-02	7.45E-03	3.70E-03	3.70E-03	2.40E-03	4.20E-03
2,4-Dimethylphenol	1.07E-02	4.06E-02	5.00E-03	8.75E-03	5.00E-03	5.00E-03	5.00E-03	5.50E-03
Ethylbenzene	8.61E-03	4.52E-02	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03
Xylenes (Total)	5.30E-02	3.56E-01	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03
INORGANICS								
Arsenic	1.01E+00	2.69E-02	6.13E-03	2.75E-02	1.66E-02	7.00E+00	3.35E-03	1.31E-02
Chromium III	8.22E+00	4.50E-03	7.84E-03	4.46E-02	2.60E-02	6.30E+00	2.25E-03	2.25E-03
Chromium VI	9.13E-01	5.00E-04	8.71E-04	4.95E-03	2.89E-03	7.00E-01	2.50E-04	2.50E-04
Copper	8.67E-01	1.00E-02	2.00E-02	1.31E-02	1.10E-02	6.00E+00	3.65E-03	5.00E-03
Nickel	1.34E+00	6.35E-01	9.44E-02	6.35E-01	4.10E-01	7.03E+00	4.06E-02	5.10E-01
Selenium	1.00E+00	2.45E-03	2.46E-03	2.45E-03	2.50E-03	7.00E+00	1.25E-03	1.20E-03
Zinc	1.38E+00	4.40E-01	1.03E-01	4.40E-01	2.25E-01	8.00E+00	0.00E+00	4.40E-01

TABLE D-5. AVERAGE SOIL CONCENTRATIONS - SITE AND HAND AUGER ZONE CONCENTRATIONS

CHEMICAL	SITE AVERAGE (mg/kg)	ZONE I AVERAGE (mg/kg)	ZONE II AVERAGE (mg/kg)	ZONE III AVERAGE (mg/kg)	ZONE IV AVERAGE (mg/kg)	ZONE V AVERAGE (mg/kg)	ZONE VI AVERAGE (mg/kg)	ZONE VII AVERAGE (mg/kg)
ORGANICS								
Bis(2-ethylhexyl)phthalate	4.71E+03	1.50E+04	1.30E+04	1.60E+02	6.80E+01	1.20E+01	0.00E+00	1.44E+01
Butyl benzyl phthalate	5.74E+00	1.70E+01	3.70E-02	3.70E-02	1.95E-01	3.70E-02	0.00E+00	1.71E+01
Di-n-butyl phthalate	8.01E+00	4.50E+00	3.00E+01	4.50E+00	7.38E+00	4.68E-01	0.00E+00	1.24E+00
Di-n-octyl phthalate	9.07E+00	2.00E+01	2.00E+01	9.50E+00	3.23E+00	4.68E-01	0.00E+00	1.24E+00
Ethylbenzene	1.90E-03	1.90E-03	1.90E-03	1.90E-03	1.90E-03	1.90E-03	1.90E-03	1.90E-03
Methylene chloride	7.29E-02	9.10E-02	3.10E-02	5.30E-02	8.15E-02	9.82E-02	1.04E-01	5.22E-02
Polycyclic aromatic hydrocarbons (PAHs)								
Benzo(a)anthracene	1.30E+00	1.80E-01	1.80E-01	1.80E-01	6.88E+00	2.00E-01	0.00E+00	1.80E-01
Benzo(a)pyrene	2.12E-01	2.10E-01	2.10E-01	2.10E-01	2.10E-01	2.25E-01	0.00E+00	2.10E-01
Benzo(b)fluoranthene/Benzo(k)fluoranthene	3.67E-01	3.40E-01	3.40E-01	3.40E-01	3.40E-01	5.05E-01	0.00E+00	3.40E-01
Benzo(g,h,i)perylene	1.98E-01	2.00E-01	2.00E-01	2.00E-01	2.00E-01	2.00E-01	0.00E+00	1.86E-01
Chrysene	3.01E-01	2.90E-01	2.90E-01	2.90E-01	2.90E-01	3.55E-01	0.00E+00	2.90E-01
Dibenzo(a,h)anthracene	6.60E-02	6.60E-02	6.60E-02	6.60E-02	6.60E-02	6.60E-02	0.00E+00	6.60E-02
Fluoranthene	2.22E-01	2.10E-01	2.10E-01	2.10E-01	2.33E-01	2.80E-01	0.00E+00	1.89E-01
Indeno(1,2,3,c,d)pyrene	2.06E-01	2.10E-01	2.10E-01	2.10E-01	2.10E-01	2.10E-01	0.00E+00	1.89E-01
Phenanthrene	3.57E-01	3.70E-01	3.70E-01	3.70E-01	3.70E-01	4.35E-01	0.00E+00	2.29E-01
Pyrene	3.11E-01	3.10E-01	3.10E-01	3.10E-01	3.05E-01	4.15E-01	0.00E+00	2.14E-01

ZONE I - Tank transmission line
ZONE II - Discharge of floor drains, Building 13
ZONE III - Discharge of floor drains, Building 14
ZONE IV - Loading dock, Building 13
ZONE V - Parking Lot, east of Railroad Right of Way
ZONE VI - Parking Lot, west of railroad Right of Way
ZONE VII - Building 9 Loading Dock

TABLE D-5. AVERAGE SOIL CONCENTRATIONS - SITE AND HAND AUGER ZONE CONCENTRATIONS (continued)

CHEMICAL	SITE AVERAGE (mg/kg)	ZONE I AVERAGE (mg/kg)	ZONE II AVERAGE (mg/kg)	ZONE III AVERAGE (mg/kg)	ZONE IV AVERAGE (mg/kg)	ZONE V AVERAGE (mg/kg)	ZONE VI AVERAGE (mg/kg)	ZONE VII AVERAGE (mg/kg)
Tetrachloroethene	5.15E-03	7.90E-03	4.70E-03	5.00E-03	4.46E-03	4.76E-03	4.70E-03	4.54E-03
Toluene	3.40E-03	3.40E-03	3.40E-03	3.40E-03	3.40E-03	3.40E-03	3.40E-03	3.40E-03
Xylenes (total)	4.88E-03	4.75E-03	4.70E-03	5.00E-03	4.46E-03	4.76E-03	4.70E-03	5.64E-03
INORGANICS								
Antimony	1.48E+02		4.13E+02	2.33E+01	1.13E+02	1.24E+02		2.14E+02
Cadmium	7.20E+00		1.62E+01	2.70E+00	4.80E+00	5.35E+00		1.42E+01
Chromium III	5.74E+01		7.07E+01	1.87E+01	1.86E+01	2.28E+02		8.80E+00
Chromium VI	6.38E+00		7.86E+00	2.08E+00	2.07E+00	2.53E+01		9.78E-01
Copper	5.83E+01		8.79E+01	9.04E+01	8.82E+01	7.10E+01		
Lead	3.86E+02		6.93E+02	2.15E+02	1.39E+02	1.26E+03		8.10E+00
Mercury	7.75E-01		1.60E+00	1.50E+00	2.50E-01	4.50E-01		8.50E-01
Nickel	4.34E+00				9.78E+00	1.00E+01		6.28E+00
Thallium	1.47E-01		5.00E-03	5.00E-03	3.20E-01	5.45E-01		5.00E-03
Zinc	1.93E+02		3.89E+02	3.67E+02	1.22E+02	2.39E+02		4.19E+01

ZONE I - Tank transmission line
ZONE II - Discharge of floor drains, Building 13
ZONE III - Discharge of floor drains, Building 14
ZONE IV - Loading dock, Building 13
ZONE V - Parking Lot, east of Railroad Right of Way
ZONE VI - Parking Lot, west of railroad Right of Way
ZONE VII - Building 9 Loading Dock

TABLE D-6. AVERAGE SOIL CONCENTRATIONS - SITE AND TEST PITS

CHEMICAL	SITE AVERAGE (mg/kg)	AREA I - Former Impoundment Zone AVERAGE (mg/kg)	AREA I - Tank Farm AVERAGE (mg/kg)	AREA I - Smog Hog Tanks AVERAGE (mg/kg)	AREA I - Parking Lot AVERAGE (mg/kg)	AREA I - West of Building 12 AVERAGE (mg/kg)
ORGANICS						
Acetone	6.32E+00	4.50E-04	2.30E-03	8.60E-02	0.00E+00	6.00E-06
Aroclor 1254	7.76E-01	0.00E+00	1.50E-04	1.50E-04	0.00E+00	0.00E+00
Benzene	2.53E+03					
Bis(2-ethylhexyl)phthalate	7.12E+00	1.50E+01	3.00E+01	2.60E+01	0.00E+00	0.00E+00
Butyl benzyl phthalate	9.45E-02	1.10E-01	5.10E-02	8.00E-05	8.00E-05	8.00E-05
Di-n-butyl phthalate	1.77E+01	1.40E-04	5.50E-03	1.40E-04	1.40E-04	1.40E-04
Di-n-octyl phthalate	2.93E+00	1.10E-01	5.90E-01	2.30E-04	1.85E-04	1.98E-04
Ethylbenzene	1.59E+00	1.70E+00	2.10E-03	3.90E-01	1.00E-06	1.00E-06
Methyl ethyl ketone	5.90E-02	0.00E+00	2.00E-06	9.50E-02	1.00E-06	1.00E-06
Methylene chloride	1.67E-01	3.10E-01	5.00E-06	1.50E-02	9.00E-06	0.00E+00
Polyaromatic Hydrocarbons (PAHs)						
Benzo(a)anthracene	2.07E-01	2.30E-03	5.00E-05	5.20E-05	5.00E-05	5.40E-05
Benzo(a)pyrene	7.78E-02	2.30E-03	4.70E-05	1.90E-04	4.70E-05	4.70E-05
Benzo(b)fluoranthene/Benzo(k)fluoranthene	1.54E-01	6.78E-04	5.80E-05	3.90E-04	5.80E-05	8.90E-05
Benzo(g,h,i)perylene	4.35E-02	1.60E-03	4.50E-05	1.00E-04	4.50E-05	4.50E-05
Chrysene	3.48E-01	2.60E-03	4.40E-05	2.30E-04	4.40E-05	7.00E-05
Dibenzo(a,h)anthracene	4.95E-02	9.50E-04	3.90E-05	3.90E-05	3.90E-05	3.90E-05
Fluoranthene	7.16E-02	4.40E-03	2.00E-05	3.80E-04	2.00E-05	5.70E-05
Indeno(1,2,3,c,d)pyrene	3.26E-01	3.70E-04	4.60E-05	9.30E-05	4.60E-05	4.60E-05
Phenanthrene	3.20E-03	4.60E-03	4.20E-05	1.70E-04	4.20E-05	4.20E-05
Pyrene	8.41E-02	3.90E-03	5.00E-05	3.70E-04	5.00E-05	7.50E-05
Tetrachloroethene	7.70E-02	1.80E-05	3.00E-06	3.00E-06	3.00E-06	3.00E-06
Toluene	3.57E-02	3.70E-02	3.90E-04	2.00E-06	2.00E-06	2.00E-06
Xylene (total)	8.27E+01	7.40E+00	6.80E-03	1.20E+00	3.00E-06	3.00E-06

TABLE D-6. AVERAGE SOIL CONCENTRATIONS - SITE AND TEST PITS (continued)

CHEMICAL	SITE AVERAGE (mg/kg)	AREA I - Former Impoundment Zone AVERAGE (mg/kg)	AREA I - Tank Farm AVERAGE (mg/kg)	AREA I - Smog Hog Tanks AVERAGE (mg/kg)	AREA I - Parking Lot AVERAGE (mg/kg)	AREA I - West of Building 12 AVERAGE (mg/kg)
INORGANICS						
Antimony	1.51E+01	5.41E+01		1.33E+01	2.48E+01	6.00E-02
Cadmium	3.73E+00	1.65E+00		6.52E-01	1.47E+00	5.00E-03
Chromium III	1.90E+01	4.71E+01		2.10E+01	1.91E+01	1.04E+01
Chromium VI	2.11E+00	5.24E+00		2.34E+00	2.12E+00	1.16E+00
Copper	4.22E+01	6.14E+01		6.62E+01	5.95E+01	
Lead	1.20E+02	4.59E+02		1.33E+02	1.32E+02	7.20E+00
Mercury	1.73E+00	3.61E-01		2.50E-01	6.80E+00	2.00E-04
Nickel	1.78E-01	3.81E+01		1.06E+01	1.99E+01	1.41E+01
Thallium	1.20E-02	3.83E-02		7.50E-03	1.00E-02	1.00E-02
Zinc	2.05E+02	2.56E+02		1.49E+02	3.07E+02	
Cyanide	1.11E+00					

TABLE D-6. AVERAGE SOIL CONCENTRATIONS - SITE AND TEST PITS (continued)

CHEMICAL	SITE AVERAGE (mg/kg)	AREA II - Parking Lot by Building 14 AVERAGE (mg/kg)	AREA II - Parking Lot by River AVERAGE (mg/kg)	AREA II - Railroad Right of Wa AVERAGE (mg/kg)
ORGANICS				
Acetone	6.32E+00	6.00E-06	6.00E-06	6.00E-06
Aroclor 1254	7.76E-01	0.00E+00	1.88E-03	1.63E-04
Benzene	2.53E+03			
Bis(2-ethylhexyl)phthalate	7.12E+00	0.00E+00	2.30E-02	8.10E-03
Butyl benzyl phthalate	9.45E-02	8.00E-05	1.10E-03	8.00E-05
Di-n-butyl phthalate	1.77E+01	1.40E-04	1.40E-04	2.07E-04
Di-n-octyl phthalate	2.93E+00	1.90E-04	4.20E-04	2.07E-04
Ethylbenzene	1.59E+00	1.00E-06	1.00E-06	1.00E-06
Methyl ethyl ketone	5.90E-02	1.00E-06	1.00E-06	1.00E-06
Methylene chloride	1.67E-01	3.00E-06	3.00E-06	5.00E-06
Polyaromatic Hydrocarbons (PAHs)				
Benzo(a)anthracene	2.07E-01	3.70E-04	1.10E-03	7.00E-05
Benzo(a)pyrene	7.76E-02	7.70E-05	9.00E-04	6.90E-05
Benzo(b)fluoranthene/Benzo(k)fluoranthene	1.54E-01	3.80E-04	1.50E-03	1.17E-04
Benzo(g,h,I)perylene	4.35E-02	5.00E-05	4.10E-04	5.37E-05
Chrysene	3.48E-01	3.90E-04	1.10E-03	7.63E-05
Dibenzo(a,h)anthracene	4.95E-02	3.90E-05	1.20E-04	3.90E-05
Fluoranthene	7.16E-02	1.50E-03	1.90E-03	3.67E-04
Indeno(1,2,3,c,d)pyrene	3.26E-01	7.60E-05	3.50E-04	5.47E-05
Phenanthrene	3.20E-03	3.10E-04	1.90E-03	3.62E-04
Pyrene	8.41E-02	1.00E-03	2.20E-03	6.75E-04
Tetrachloroethene	7.70E-02	3.00E-06	3.00E-06	3.00E-06
Toluene	3.57E-02	2.00E-06	2.00E-06	2.00E-06
Xylene (total)	8.27E+01	3.00E-06	3.00E-06	3.00E-06

TABLE D-6. AVERAGE SOIL CONCENTRATIONS - SITE AND TEST PITS (continued)

CHEMICAL	SITE AVERAGE (mg/kg)	AREA II - Parking Lot by Building 14 AVERAGE (mg/kg)	AREA II - Parking Lot by River AVERAGE (mg/kg)	AREA II - Railroad Right of Wa AVERAGE (mg/kg)
INORGANICS				
Antimony	1.51E+01	6.00E-02		
Cadmium	3.73E+00	5.00E-03		
Chromium III	1.90E+01	1.39E+01		
Chromium VI	2.11E+00	1.54E+00		
Copper	4.22E+01	1.25E-02		
Lead	1.20E+02	3.68E+01		
Mercury	1.73E+00	5.00E-01		
Nickel	1.76E-01	1.17E+01		
Thallium	1.20E-02	5.00E-03		
Zinc	2.05E+02			
Cyanide	1.11E+00			

TABLE D-6. AVERAGE SOIL CONCENTRATIONS - SITE AND TEST PITS (continued)

CHEMICAL	SITE AVERAGE (mg/kg)	AREA III - Starch Drying Beds AVERAGE (mg/kg)	AREA III - Deslzing Process Waste Tank AVERAGE (mg/kg)	AREA III - Smog Hog Tanks AVERAGE (mg/kg)	AREA III - MEK Tanks AVERAGE (mg/kg)
ORGANICS					
Acetone	6.32E+00	4.75E-04	6.00E-06	6.32E-03	6.00E-03
Aroclor 1254	7.76E-01	0.00E+00	0.00E+00	7.76E-04	0.00E+00
Benzene	2.53E+03				2.15E+02
Bis(2-ethylhexyl)phthalate	7.12E+00	1.72E+00	2.15E-01	2.53E+00	2.13E+01
Butyl benzyl phthalate	9.45E-02	4.07E-02	2.13E-02	7.12E-03	1.00E-03
Di-n-butyl phthalate	1.77E+01	1.40E-04	1.40E-04	2.67E-04	1.00E-03
Di-n-octyl phthalate	2.93E+00	1.16E-02	2.00E-04	1.21E-02	2.64E+00
Ethylbenzene	1.59E+00	1.00E-06	1.00E-06	1.77E-02	1.00E-03
Methyl ethyl ketone	5.90E-02	1.00E-06	1.00E-06	1.59E-03	0.00E+00
Methylene chloride	1.67E-01	3.00E-06	4.00E-06	7.04E-03	1.70E-01
Polycyclic aromatic hydrocarbons (PAHs)					
Benzo(a)anthracene	2.07E-01	2.81E-04	5.00E-05	1.47E-04	5.80E-02
Benzo(a)pyrene	7.78E-02	7.74E-05	4.70E-05	9.91E-05	4.50E-02
Benzo(b)fluoranthene/Benzo(k)fluoranthene	1.54E-01	5.91E-04	5.80E-05	2.07E-04	4.40E-02
Benzo(g,h,i)perylene	4.35E-02	5.94E-05	4.50E-05	7.78E-05	3.90E-02
Chrysene	3.48E-01	2.71E-04	4.40E-05	1.54E-04	2.95E-02
Dibenzo(a,h)anthracene	4.95E-02	3.90E-05	3.90E-05	4.35E-05	4.10E-02
Fluoranthene	7.16E-02	1.19E-03	2.95E-05	3.48E-04	4.60E-02
Indeno(1,2,3,c,d)pyrene	3.26E-01	6.27E-05	4.60E-05	7.16E-05	5.00E-02
Phenanthrene	3.20E-03	2.04E-03	4.25E-05	3.27E-04	3.63E-03
Pyrene	8.41E-02	8.26E-04	5.00E-05	3.26E-04	2.00E-03
Tetrachloroethene	7.70E-02	3.00E-06	3.63E-06	3.20E-06	7.70E-02
Toluene	3.57E-02	4.55E-05	2.00E-06	8.41E-05	2.87E-03
Xylene (total)	8.27E+01	4.64E-05	3.00E-06	8.27E-02	3.00E-03

TABLE D-6. AVERAGE SOIL CONCENTRATIONS - SITE AND TEST PITS (continued)

CHEMICAL	SITE AVERAGE (mg/kg)	AREA III - Starch Drying Beds AVERAGE (mg/kg)	AREA III - Desizing Process Waste Tank AVERAGE (mg/kg)	AREA III - Smog Hog Tanks AVERAGE (mg/kg)	AREA III - MEK Tanks AVERAGE (mg/kg)
INORGANICS					
Antimony	1.51E+01	2.55E+01	3.07E+00		6.00E-02
Cadmium	3.73E+00	1.03E+00	3.37E-01		2.47E+01
Chromium III	1.90E+01	1.68E+01	1.31E+01		1.08E+01
Chromium VI	2.11E+00	1.87E+00	1.46E+00		1.20E+00
Copper	4.22E+01	3.96E+01	2.64E+01		
Lead	1.20E+02	1.13E+02	6.78E+01		1.04E+01
Mercury	1.73E+00	1.95E+00	3.97E+00		2.52E-02
Nickel	1.78E-01	1.05E+01	8.50E+00		2.41E-01
Thallium	1.20E-02	1.00E-02	5.00E-03		1.00E-02
Zinc	2.05E+02	1.70E+02	1.44E+02		
Cyanide	1.11E+00	1.20E+00	1.01E+00		

APPENDIX E

TABLE E-1

STREAM SEDIMENT CONCENTRATIONS, DRAINAGE DITCH						
	DRAINAGE DITCH			MINIMUM	AVERAGE	MAXIMUM
ORGANICS (mg/kg)	5	7	8			
Bis(2-ethylhexyl)phthalate	5.20E+02	6.90E-01		6.90E-01	2.60E+02	5.20E+02
Di-n-butyl phthlate	3.80E-01	5.80E-02		5.80E-02	2.19E-01	3.80E-01
Ethylbenzene	1.70E-02	3.50E-03	3.00E-03	3.00E-03	7.83E-03	1.70E-02
Methylene chloride	2.90E-02			2.90E-02	2.90E-02	2.90E-02
Naphthalene		7.40E-02		7.40E-02	7.40E-02	7.40E-02
Polyaromatic hydrocarbons (PAHs)						
Anthracene	4.90E-01	5.60E-02		5.60E-02	2.73E-01	4.90E-01
Benzo(a)anthracene	1.60E+00	2.70E-01		2.70E-01	9.35E-01	1.60E+00
				2.70E-01	9.35E-01	1.60E+00
Benzo(a)pyrene	1.50E+00	2.10E-01		2.10E-01	8.55E-01	1.50E+00
				2.10E-01	8.55E-01	1.50E+00
Benzo(b)fluoranthene/Benzo(k)fluoranthene	3.80E+00	4.10E-01		4.10E-01	2.11E+00	3.80E+00
				4.10E-01	2.11E+00	3.80E+00
Benzo(g,h,i)perylene	7.10E-01	2.60E-01		2.60E-01	4.85E-01	7.10E-01
Chrysene	2.50E+00	3.60E-01		3.60E-01	1.43E+00	2.50E+00
				3.60E-01	1.43E+00	2.50E+00
Dibenzo(a,h)anthracene		6.40E-02		6.40E-02	6.40E-02	6.40E-02
				6.40E-02	6.40E-02	6.40E-02
Fluoranthene	4.00E+00	3.20E-01		3.20E-01	2.16E+00	4.00E+00
Indeno(1,2,3,c,d)pyrene	5.50E-01	1.90E-01		1.90E-01	3.70E-01	5.50E-01
				1.90E-01	3.70E-01	5.50E-01
Phenanthrene	1.80E+00	3.70E-01		3.70E-01	1.09E+00	1.80E+00
Pyrene	3.50E+00	3.60E-01		3.60E-01	1.93E+00	3.50E+00
Xylenes (total)	2.20E-01	3.00E-03	3.00E-03	3.00E-03	7.53E-02	2.20E-01
INORGANICS (mg/kg)						
Arsenic	1.40E+01			1.40E+01	1.40E+01	1.40E+01
Beryllium	8.00E-01			8.00E-01	8.00E-01	8.00E-01
Cadmium	2.10E+00			2.10E+00	2.10E+00	2.10E+00
Chromium (as Cr III)	2.43E+01			2.43E+01	2.43E+01	2.43E+01
Chromium (as Cr VI)	2.70E+00			2.70E+00	2.70E+00	2.70E+00
Copper	5.60E+01			5.60E+01	5.60E+01	5.60E+01
Lead	1.56E+02			1.56E+02	1.56E+02	1.56E+02
Mercury	1.10E+01			1.10E+01	1.10E+01	1.10E+01
Nickel	1.90E+01			1.90E+01	1.90E+01	1.90E+01
Zinc	2.82E+02			2.82E+02	2.82E+02	2.82E+02